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President HOWARD MONROE RAYMOND, *B.S., D.Sc.*

ARMOUR INSTITUTE OF TECHNOLOGY

"The new form and style of THE ARMOUR ENGINEER should be an added stimulus in perpetuating the Armour spirit among our students and alumni, and I appreciate the happy privilege which this first issue affords me of conveying my greetings to every young man who has ever attended or is now enrolled in the Armour Institute of Technology.

"We shall continue to train our students to assume positions of efficient leadership in the industrial life of today. Our efforts will be directed toward training them scientifically, so that they will make not only good engineers, but, what is of greater importance, to prepare them for the highest citizenship; to fit them to assume human duties of responsibility, and to dedicate their powers of knowledge and genius of research to the common good and the upbuilding of new ideals. Let us have the co-operation and unswerving loyalty of every Armour man in the effort to make a broader, better, stronger, and nobler Armour Institute of Technology."

—H. M. RAYMOND.

A SNAPSHOT AT FIRE PREVENTION

Richard E. Vernor, *Manager*

Fire Prevention Department, Western Actuarial Bureau.

THE South Sea Islanders started something when they twisted a stick in a groove. Innumerable statistics have been published indicating the extent of our frightful fire waste. The figures are so staggering that average human intelligence can scarcely grasp them. In this educated and civilized country a human life is sacrificed to carelessness by fire every thirty minutes, and the victim is usually a child or a mother. The cost of our national ash heap is about one billion dollars per annum. We are gradually coming to a realization of the enormity of this crime, and find ourselves casting about for a remedy.

When the water pipes get out of order we call for a plumber, if in legal difficulty we solicit the services of a lawyer. It is logical, then, that finding ourselves in the grasp of the Fire Demon we should call for the aid of a diagnostician of fire causes—the fire insurance specialist. We are then advised that the causes of our difficulty are three in number. The natural causes are few—lightning, earthquake and tornado. The so called moral causes of fire may be divided into two classes, incendiarism and the result of indifference or deliberate carelessness. The physical causes of fire are many, but almost entirely preventable.

Most of our great conflagrations have been the result of extremely simple causes. Five of our large fires, where losses have ranged from one to forty million dollars, started from these elementary hazards: An electric iron, a locomotive spark, a cigarette dropped through a glass bull's-eye, an ignited ball of cotton, and the keeping of unslaked lime in a wet basement.

We may assume then, that as the causes of our fires are simple, the remedy should not be complex. The medicine which will cure us is composed of common sense and carefulness. It is largely a matter of education for those with an open mind, and one of coercion for the heedless. Europe has long since learned the value of carefulness. The average immigrant to this land from certain European countries fears the consequences of having a fire. Witness the case of one of our central western cities having a population of ten thousand, largely of foreign birth. Up to date there has not been a single fire alarm this year! How many American-born cities of ten thousand can say as much?

If education in fire carefulness has been successful in Europe is there any good reason why it should not be so here? The fact is that where we Americans have locally developed constructive and intelligent campaigns the results have been astounding. Cincinnati is saving itself some \$850,000 per annum in fire insurance premiums. Detroit in 1921, in the face of a bad moral hazard and an increased population, reduced its fires by 508 and its false alarms by 122 over the year previous. Another city of 40,000 has had seventy fewer fires so far this year than during the same period a year ago. The Chicago Safety Council reported that in connection with a recent Fire and Accident Week campaign, "The saving in fire loss for this one week alone represented over eleven times the total cost of the campaign." Still another sensible city listened to the advice of the fire doctor and eliminated seventy hazards in its public schools. It has been demonstrated that time and expense spent in practical fire prevention constitute capital well invested.

Contrary to popular opinion, it is quite reasonable for fire insurance interests to lend all possible assistance to fire prevention. The risks upon which profits are made are those which do not burn. No matter how high a rate may be, the company writing the line loses if the risk is destroyed. Most of the risks which the average company refuses to write carry high rates. Even the insurance man knows that when an article is burned its intrinsic value passes off into thin air in the form of heat energy, and that economically the country is poorer by just that amount. An occasional fire if not too serious does serve as an advertising medium, but this form of advertising at its present expense will bankrupt us as a nation. Then too, insurance as a profession is morally obligated to disseminate the result of its experience. No other institution has the information available which can be used to retard this fearful waste.

Perhaps the greatest result from the point of view of insurance as an institution is the gaining of public good will and the creation of a better understanding between the insuring public and the insurance fraternity. Fire prevention opens up to us a medium through which we can prove that our desire to be of public service is sincere.

Thus in serving our community well we are promoting our own prosperity.

When Abraham Lincoln was a young man he ran for the legislature in Illinois, and was badly swamped. He next entered business, failed, and spent seventeen years of his life paying up the debts of a worthless partner. He was in love with a beautiful young woman, to whom he became engaged—then she died. Later he married a woman who was a constant burden to him. Entering politics again, he ran for congress and again was badly defeated. He then tried to get an appointment to the United States land office, but failed. He became a candidate for the United States senate; and was badly defeated. In 1856 he became a candidate for the vice-presidency, and was once more defeated. In 1858 he was defeated by Douglas. One failure after another—bad failures—great setbacks. In the face of all this he eventually became one of the greatest men of America, whose memory is honored and loved throughout the world. When you contemplate the effect of a series of setbacks like this, doesn't it make you feel kind of small to become discouraged, just because you think you are having a hard time of life?—*Prætorian Guard.*

"Do it today" is a good motto, but the chap who can say "I did it yesterday" has a better one.

—*Underwriters Data.*

ADVERTISING FOR THE PRACTICING ENGINEER

By

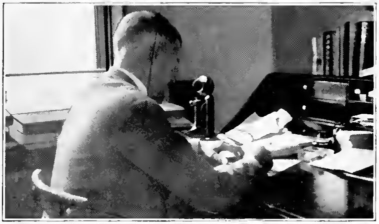
MORRIS W. LEE, M. E., '99

THE subject of Advertising for the Practicing Engineer is a somewhat controversial one, so that it might be clarified at the outset, and we might all arrive at a more substantial agreement regarding it, by first considering several questions that naturally suggest themselves in connection with it.

In the first place, what is advertising? Where does personal solicitation leave off and advertising begin? Is a professional man's name painted on his office door advertising or just a convenience?

Next, should the practicing engineer advertise? And if not, why not? How can he get business unless he goes after it in some way? Could he stay in business if nobody knew about him? If not a single firm or individual knew of a particular engineer's capabilities, could that engineer have any outlet for his business energies or any income for his family? When we reduce our inquiry to this point, the answer is self-evident.

Then what does the practicing engineer do to get business? He starts in to tell his friends and acquaintances that he has an office or a drafting board or perhaps a draftsman, and that he is qualified to do certain work and would like some of it to do.



MORRIS W. LEE

If he has a little nerve he takes a card in an engineering paper and tells other engineers that he is at such and such an address, that he knows sewage, that he is acquainted with bridges, that he dams rivers, and expects to get a job this way. Do his fellow-engineers immediately rush over to give him some work? They do not. They simply recognize that there is another competitor in the field. This sort of advertising brings up a point I shall refer to later on, and that is, the necessity for judgment in advertising.

But, first of all, what is advertising? Neither the dictionary nor the works on advertising that I have had opportunity to read give us a definition which clearly covers that activity as we observe it today. Some say it is "printed salesmanship," some "the art of creating a new want," some "a potential science, difficult to define." They all agree, however, that advertising in its best sense is disseminating by the printed word information about an article or a service calculated to affect favorably the sale of that article or service. And they all agree that it must pay, though lots of it doesn't. Advertising is an extension of one element in selling. It is a tool, and its effectiveness depends upon the way it is used.

Now to return to our next query, "Should the practicing engineer advertise, and if not, why not?" I have talked with many engineers regarding advertising, and in all these discussions I have found no logical objection to it. Some of them say that strictly professional advertising becomes self-praise if carried beyond a simple statement of the service offered for performance. Some engineers say they prefer to let their works speak for them. Yet these same engineers countenance and even promote the publication of articles descriptive of their works, in order that they may be more widely known, and if the engineer's name does not appear in the article he is disappointed, to say the least. If his name does appear he is very apt to circulate reprints of the article or copies of the paper where he thinks they will do him the most good. And he may even write the article himself, to be sure to have it correct and to give the credit he feels is due him.

Now do not think that I disapprove of such a procedure. There is nothing wrong with it and it is valuable as advertising—unquestionably so. It illustrates good judgment and a perfectly proper instinct or desire, if you please, for the engineer to advertise his accomplishments.

Why then this great distinction between the text pages and the advertising pages of publication? Doubtless it is because the text pages are supposed to be what others say of one, and the advertising pages what one says of himself. The prospective advertiser fearing self-praise hesitates to say frankly in print about himself what he would readily tell a man to whom he wanted to sell.

Observation shows that it is easier for the engineer who sells materials, or who contracts for building work, to say more by the printed word in praise of his work than if he rendered a purely personal service. His works or his goods speak for him in addition to what he says of himself, and some self-consciousness is thus done away with. General education and the gradual growth of custom also seem to make this sort of advertising easier for the engineer.

The best test of whether advertising is ethical or not is the test of its truthfulness. If it states the truth there is no justifiable objection to it. Only the statement of untruth is to be condemned, and this will fail of its own weakness in due course without other condemnation.

It would seem logical therefore that we should agree that there is no sound reason from an ethical, moral or business standpoint why the engineer should not advertise.

The proposition then narrows down to "will it pay?" and that is a far more difficult question to answer. For many engineers it doubtless would not, while for some, who exercised the necessary skill, care and perseverance, it unquestionably would pay, and would pay well.

A good many practicing engineers are in the position of the Arkansas hilly-billy who didn't need to mend his roof when the sun shone, and couldn't do so when it rained: when they have enough business to bring them in a sufficient income they don't need to advertise, and they can't pay for advertising if they have no business.

Some engineers can afford to, or do afford to, continue in business until they can build up a reputation by word of mouth, but is it the best plan? Roy Durstine says: "Advertising came into the world because men were too impatient to wait for Mrs. Jones to tell Mrs. Smith that Brown's pickles were good to eat. Brown discovered that he could tell two million Mrs. Smiths and Mrs. Joneses about his pickles, and that he could sell a lot more pickles that way than by waiting for the news to leak out by itself.

"'But,' says Brown's partner, 'I believe in word-of-mouth advertising.'

"'So do I,' agreed Brown, 'But it takes too long.'

"'What I mean is this', his partner went on: 'If Mrs. Jones tells Mrs. Brown, she'll believe it. If we tell her, she'll think we are trying to put something over.'

"'That depends on how we tell her,' said Brown."

This little story illustrates what I said about advertising being an extension of selling, and that its effectiveness depends very largely on the way it is employed. The results from advertising, whether it refers to pickles or engineering service, depend on how you tell the story.

Anyone who has been in engineering practice realizes that it takes quite a long time to develop a good engineer, even after he leaves college. To be a good engineer his judgment must be developed. The same thing is true in advertising.

Advertising is not merely buying space and filling it with type matter or sending out circular matter. Advertising, like any other business or profession, requires judgment, and there are far less specific data from which to form that judgment than exists in engineering practice.

First there is judgment required as to the proper appropriation; then the local, national or trade mediums to be employed, the method of approach, the selection of the idea or ideas best calculated to produce the desired end, the choice of advertising agency if one is employed, the style and wording of copy, use of illustration, and so on. Good judgment is required in practically all of these items if the advertising is to pay. And it *must* pay.

Edward Bok, for many years editors of the *Ladies' Home Journal*, told an inquirer that of all the campaigns he had seen put over through the Curtis publications, the most effective ones were those embodying a real idea. A real idea has intrinsic vitality. It is active. If you can get it across to the other fellow so that he can grasp it, the idea will be active in his consciousness and keep on working for you. If you can put a real idea into an advertisement, other things being equal, such an advertisement will be more effective than one which is a mere aggregation of statements or otherwise commonplace in its make-up.

A very natural query at this point would be how much money an engineer ought to spend in order to make his advertising pay, but that is a question to which no general reply can be given. I should say that the engineer should start with a publication which he believes will reach most effectively his particular *clientele.* Let him use that publication intensively, focusing his effort upon that particular line of industry.

For example, a paper mill engineer should start out in a publication reaching paper mill owners; the designer of textile plants should use a medium such as *The Textile World;* the foundry engineer will naturally turn to *Foundry* and similar papers; and so on. The temptations will be great to spread out with small cards or small spaces in a large list of papers or directories, but this temptation should be resisted.

The sellers of advertising space employ for the most part good solicitors, and when they find there is an advertising appropriation to be allotted, they are very industrious in trying to secure a part of it. So when an engineer starts out on an advertising campaign he must be prepared to resist these blandishments, and stick to his own best judgment, because he is the one who has to stand or fall by the results.

There is a great deal of direct mail advertising being done nowadays, and a lot of it is productive. The difficulty with it is that during the past few years this method of advertising has been very largely fostered and has increased greatly in volume. There is therefore much more competition for attention in the mail reaching a man's desk, day by day. This means that direct mail advertising to be effective must be high class in character and distributed with discretion if such advertising is to be productive of results. This is only another illustration of the judgment required in advertising. Of course judgment is developed, as in other fields, by the practical use of advertising and the observation of results secured.

So let the practicing engineer or firm of engineers, if they want to advertise, start out on a moderate scale. Let them state clearly the work they are prepared to do, and why they are qualified to do it. Let them show specific examples of work well done and favorable comments on their accomplishments.

If they place these announcements in reputable papers circulating among buyers of such engineering services as they supply, they will get inquiries. Then let them get out on those inquiries and work hard to sell their services. This practice and this industry in going after business is practically certain to achieve success. Advertising is a link in the chain—it widens the opportunity of the appeal—but the other links must be welded to it to make the advertising effective.

There is another aspect of advertising for the engineer that I have not touched upon, and that is its effect upon popular opinion. Popular opinion or custom seems at present to set curious limits as to who may or may not properly advertise; but as this consensus of thought becomes less arbitrary, and broadens through observation of good engineering advertising, there will be more opportunity for the practicing engineer to advertise.

There is not as much solidarity among the engineering profession as there well might be.. There is also a reticence among engineers, individually and collectively, about putting themselves forward and making their achievements known. Consequently the public at large talks loosely about "great engineering feats" as if they were merely manifestations destined to appear in the

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"PITTSBURGH PLUS"

The Interest of the Nation in the Now Famous Controversy Over Steel Price Basing; the Charges Brought Against the Practice and the Defense Made for It.

By

Frank Emerich, Publicist

EFFICIENT and economical production is the watchword of today and the by-word of tomorrow in American industry.

Every factor which makes for economic efficiency in industry must be utilized if this nation is to maintain its present outstanding position in the world, for it is conceded that, once the process of readjustment abroad is completed, we shall face stiffer industrial competition than ever before. Therefore, it behooves this country to pay close attention to every factor which enters into productive industry; to take strict account of its present practices, in order to see if they are the best adapted to present and future industrial exigencies, and to divest itself of any customs or practices which hamper or threaten to hamper its industrial efficiency.

These things will be generally conceded. Captains of industry, while they have various solvents to offer for present ills and numerous theories to put forward regarding our future course, all agree upon these fundamentals.

Among the industries in which this nation today holds unquestioned leadership steel is one of the foremost and most important. This period of our history could, with absolute justification, be called "The Steel Age," for steel plays a leading part in the entire industrial fabric of the world. Therefore, anything which pertains to the steel industry is of paramount importance, and any practice prevailing in that industry which threatens to impair its utmost efficiency is not only of grave import to the industry itself but to the entire nation.

This renders a discussion of the practice in the steel trade known as "Pittsburgh Plus" of more than usual interest, for it is charged that this practice promotes inefficiency; maintains unjustifiably high price levels; centers the steel industry at a production point where the greatest economy and efficiency are not to be obtained, and promotes the continued existence of high cost, and inefficient steel mills, to the detriment of all of the other branches of industry which are dependent upon steel as a basic commodity.

What, then, is "Pittsburgh Plus"?

Reduced to its simplest terms, it is a custom in the steel trade which has been in more or less continuous existence since 1901, and is the practice of charging for all rolled steel, no matter where made or where sold, at the Pittsburgh mill price plus the freight from Pittsburgh to destination. That is, it is the practice of selling all rolled steel—except rails—f. o. b. Pittsburgh.

The results of this practice is apparent at a glance. It means that the manufacturer who uses rolled steel in the production of his commodity buys his basic material cheaper if he is located in or near Pittsburgh than he would if located anywhere else in the country, no matter how close he may be to a steel mill elsewhere.

This means that manufacturers in or about Pittsburgh—in what is generally known in the steel trade as "The Pittsburgh District"—enjoy a tremendous advantage over manufacturers in any other section of the country.

This has been resented by western and southern manufacturers, who have brought an action before the Federal Trade Commission designed to have the "Pittsburgh Plus" practice abolished.

The question at issue is, therefore:

Is "Pittsburgh Plus" justified?

The western and southern manufacturers say it is not; that it is contrary to all fairness; all economic law, and that it acts to strangle industry elsewhere than in and about Pittsburgh. They assert that it imposes an unfair burden upon western and southern industry and also a decidedly unfair burden upon the entire country, apart from the Pittsburgh district, in causing an unjustifiably high level of commodity prices.

The steel mills, not only in Pittsburgh but all over the country (for all of the mills benefit in pocket from the "Pittsburgh Plus" practice), defend this custom on the ground that it exists solely because of the law of supply and demand, and that it has an absolute economic justification.

It is worth while closely to examine into these conflicting claims; and, because the prevailing practice has the respectability which inheres to present and long time prior usage, the reversal of the usual order of argument by the giving of the defense for the practice first and the charges against it afterward is not only justified, but is, perhaps, the best method of approaching the controversy.

Briefly, the steel mills defend "Pittsburgh Plus" on this ground:

They say Pittsburgh (and by Pittsburgh is meant the so-called Pittsburgh district, embracing an area centering in Pittsburgh and having a radius of about seventy-five miles) is the coutry's surplus steel producer. They assert that no other section of the country produces sufficient steel to meet its own needs—this applying especially and particularly to the Chicago steel district—and that the shortage of supply under demand in these districts makes it necessary to call upon Pittsburgh for the additional supply needed.

On this theory they say that were it not for the "Pittsburgh Plus" practice, the early purchasers of steel in the Chicago district, for illustration, would buy from the mills in and about Chicago at one price, and the later purchasers, those who place their orders after the Chicago mill supply is exhausted, would be obliged to buy in Pittsburgh and pay the mill price at Pittsburgh and the freight from Pittsburgh in addition. This they assert would be unjust, inasmuch as it would be a discrimination in price between customers, and they therefore claim that "Pittsburgh Plus" is a thoroughly sound economic device, designed to equalize prices to all purchasers of steel, no matter where they buy or at what time, and to effect a much needed stability in the steel market.

This mills call this "the working of the inexorable economic law of supply and demand," and they further assert that in periods of dullness, when demand does not equal supply, the "Pittsburgh Plus" practice is disregarded.

This, in brief, constitutes the defense which the mills offer for utilizing the "Pittsburgh Plus" device, although they have an additional defense to the charge that it tears down or restricts industry in the west, in the claim that all present western industry was practically upbuilt during the period in which "Pittsburgh Plus" has been the rule.

Briefly, then, their defense for the practice is threefold, namely:

1. It is in response to an inexorable economic law, the law of supply and demand, and therefore is not to be charged against the mills as a voluntary practice.

2. That it effects the stabilization of the steel market, and therefore works to the benefit of the entire steel trade.

3. That it has been in effect over a long period of years, and present industry has been upbuilt under it.

The mills say further that if the time ever comes, or when the time does come, that some other steel producing district, such as Chicago, passes Pittsburgh as a point of surplus production, then Pittsburgh's primacy in the steel trade will pass, and the new point of large production will become the steel center naturally, and prices will be based upon it instead of upon Pittsburgh.

This comprises the complete defense of the mills for the prevailing practice. On its surface it seems a good defense, but it is strongly assailed by the steel manufacturing interests in the south and west, and by the consumers of those sections, and apparently it has many vulnerable points.

In attacking "Pittsburgh Plus," western manufacturers first go to the root of the entire system of production, and inquire into the question of costs. They assert that steel is made more cheaply in the Chicago district than it is at Pittsburgh. They claim that this difference in cost is considerable, and that it is absurd for manufacturers located in the Chicago district to pay more for their steel than those in Pittsburgh, when the Chicago mills produce steel for much less money.

This question of production cost is hotly disputed, but the western manufacturers seem to have a decided advantage of position. Neither side gives out exact figures. The western manufacturers have no figures, and the steel mills refuse to supply them. But the western men point to an address made by Judge Elbert H. Gary, Chairman of the Board of the United States Steel Corporation, before the Duluth Commercial Club in June, 1917, and from this speech they say, on Judge Gary's authority, that steel is made at Gary, Ind., for 18.12 per cent less than at Pittsburgh.

Since conditions in the entire Chicago district are fairly comparable to those which obtain at Gary, they draw the reasonable deduction that steel is or can be made throughout the Chicago district for less than at Pittsburgh.

Then come the southern manufacturers, and make similar claims regarding production cost in behalf of Birmingham. They point out that the Stanley Investigating Committee—a congressional committee which investigated the steel industry some years ago—found that steel was produced at Birmingham for approximately 18 per cent less than at Pittsburgh.

And both western and southern manufacturers inquire pointedly why "Pittsburgh Plus" was not a general practice in the steel trade prior to the formation of the U. S. Steel Corporation. This inquiry goes not only to the cost of production question, but also to the "economic necessity" argument.

They argue if "Pittsburgh Plus" is an economic necessity, it should have been in general use prior to the practical control of the steel industry by one corporation; and they say, with apparent justice, that "Pittsburgh Plus" cannot be the result of an economic law if it is only workable when the industry is closely controlled, and is not workable when free competitive conditions obtain.

They point out that prior to the formation of the U. S. Steel Corporation, the surplus production of Pittsburgh, with relation to the rest of the country, was even greater proportionately than it is today, and therefore there was the same reason for the existence of "Pittsburgh Plus" if that practice is solely due to economic causes. They then show that "Pittsburgh Plus" was by no means standard practice until there was close control of the industry.

On the production cost theory, however, the fact is that Pittsburgh in 1901 probably produced steel cheaper than any other point, since the Gary mill of the U. S. Steel Corporation was not then in existence, and most of the other mills in the Chicago district were small. In fact, the Chicago district was then not an important producer, and probably produced at much higher cost than it does today.

This, according to the contention of the western men, harks back to the issue of cost of production as the legitimate foundation for pricing, and is strong presumptive evidence that the "economic law" cited by the mills is not the controlling factor it is claimed to be.

The western manufacturers also point to another phase of this subject, and again utilize Judge Gary's now famous Duluth speech to prove their contention. In that speech Judge Gary was explaining to his Duluth audience why the U. S. Steel Corporation could not make Duluth a basing point for steel, and he based his argument upon the fact that production costs in Duluth were too high, and that the differential embodied in the "Pittsburgh Plus" charge was necessary to enable the Duluth mills to exist and manufacture at a profit.

They seize upon this, and say that Judge Gary cannot blow hot and cold. If the high cost of making steel at Duluth requires the exaction of a greater price there, this certainly should not apply to Chicago or Birmingham, where the cost is lower.

In fact, the claim of the western manufacturers—and it appears to be well founded—is that the real "economic law" which governs prices rests fundamentally upon production costs. Admitting that at any given moment the price of any commodity is governed by the demand for it and the supply of it in any given market, the fact remains that in an untrammeled and uncontrolled market, production cost, in the final analysis, is the principal determining factor in the relation of sup-

ply to demand. With demand great and a shortage of supply, untrammeled production is speeded until supply tends to equal demand. A point is then reached at which supply not only equals but exceeds demand. When demand is great and supply short, the price rises, but when the point of surplus supply is reached, the price falls. That is elementary economics.

This being true, it follows as a logical and unassailable corollary that the producer whose product is produced at a low cost must, in the absence of artificial control, drive the high-cost producer out of his market, because when supply exceeds demand the low-cost producer can undersell his higher-cost competitor and still make a profit. Therefore, in an uncontrolled market, the superior productive facilities of the low-cost producer tend to extinguish the competition of his higher-cost rival; to bring supply to a point where it equals or exceeds demand, and thus to regulate, in a large measure, the operation of the law of supply and demand to the extent that supply must depend, under normal conditions, upon that producer who is best equipped to satisfy demand.

Judge Gary has recently made several pleas for justice in industry—justice to labor, and justice to the public. In his address of October 27, last, to the American Iron and Steel Institute in New York, he said:

"The natural law of supply and demand should not be interfered with by any government or by any administrator of the laws, except in case of turpitude, and this applies to all business transactions. There are already too many man-made laws, and perhaps too many attempts to apply them, which are calculated to interrupt and hinder progress and industry."

Farther along in the same speech he said:

"All that is necessary to prosperity in the United States is the legitimate utilization of our stupendous resources."

In this address Judge Gary made no specific reference to the question of "Pittsburgh Plus," but these two paragraphs and others of a like nature are believed to have a veiled reference to this subject.

In his insistence upon freedom from interference by "man-made law," the steel trade sees a thrust at the agitation for the abolition of "Pittsburgh Plus." But "man-made law" is the same, whether the law is the result of a statute, a judicial decision or the acts of those in control of industry.

If the so-called "law of supply and demand" which the mills invoke is really a smoke screen for an artificially controlled device which hampers industry, then it is a far more iniquitous "man-made law" than any statute or judicial decision.

The western manufacturers also assail the "Pittsburgh surplus production" theory of the mills. They claim it is not justified by the facts. They assert, and apparently with good reason, that the western mills are never permitted to approach their normal capacity except in abnormal times when demand so far exceeds supply that all mills, wherever located, are taxed to their utmost capacity.

They claim that there is something in the nature of a "gentlemen's agreement"—although they admit that they are not able to prove this—to the effect that all mills in the western district shall run to about an equal proportion of their productive capacity at all times, and that this serves to restrict production in the west.

So far as the stabilization argument is concerned, the western and southern men simply laugh at it, and apparently they have good grounds for doing so. They point to the fact that when the steel trade actually "goes to pot," which is about the only time that it requires stabilizing, "Pittsburgh Plus" does not work.

They sardonically inquire as to the value of a "stabilization" which only adds a fixed sum to the price at any particular point, and assert that this kind of "stabilization" only "stabilizes" mill profits at a high level.

Regarding the fact that the practice has been in existence for a considerable time, the western men inquire pointedly if age can lend respectability to viciousness.

Really it seems plain enough that the so-called "stabilization" and "length of existence" arguments are without much point. Reduced to its final analysis, the mills' defense must rest entirely upon the "economic law of supply and demand" argument.

On its face, this is not only plausible but logical. Inquired into at close range, however, it loses practically all of its logic and much of its plausibility.

Admittedly steel rails are not sold upon a Pittsburgh base. No fictitious or imaginary freight is charged upon them, but the railroads buy them at the mill—no matter where the mill is located—at mill prices and pay only the actual earned freight in those cases where they do not haul the rails themselves.

If there is "an immutable and inexorable law of supply and demand" which governs steel trade prices and insists inflexibly that "Pittsburgh Plus" is an economic necessity, then it must apply with equal force to all steel products. It does not apply to rails. Therefore, in the absence of some other equally important factor, it is plain that the "economic law" cited by the mills can be neither "inexorable" nor "immutable."

The same thing holds true of pig iron. If the law of supply and demand regulates steel prices and insists that the point of so-called surplus production is entitled to an advantage over any other points of production, then pig iron would be sold at the furnace price plus freight from that district in which it was produced in greatest quantities. This, however, is not the case. Pig iron is sold f. o. b. furnace everywhere; and yet if there is an economic law which governs steel, it certainly should govern a product so closely allied to it as pig iron. In fact, it should govern all basic products, but it does not.

A still more vivid argument against the contention of the mills that "Pittsburgh Plus" exists solely because of economic law is furnished by the situation at Birmingham, Ala.

Birmingham is a considerable producer of steel. Its trade territory is the south. Admittedly it produces more steel than the south consumes. Yet there is no "Birmingham base."

On the other hand, steel is not sold in the south on a Pittsburgh base. That is, "Pittsburgh Plus" is modified in the south. Instead of charging the full imaginary freight at Birmingham, the U. S. Steel Corporation,

which is practically in entire control of the Birminham situation, makes an arbitrary differential of $5 per ton over the Pittsburgh mill price, and charges this in the south.

That's a curious situation, and one which the steel mills have not yet explained satisfactorily. In fact, they do not explain it at all, and to the uninitiated it would seem beyond explanation.

Plainly, there is and can be no such thing as an "arbitrary differential" contemplated in any economic law. That is patently impossible.

If Birmingham is a surplus producer of steel, then, on the theory of the steel mills, steel at Birmingham should be sold on a mill base, at least on a parity with Pittsburgh.

If Birmingham is not a surplus producer of steel, but is compelled to draw upon the surplus of Pittsburgh to supply its needs, then on the "economic law" theory of the mills, Birmingham should pay the full "Pittsburgh Plus."

It does neither.

Instead it pays this arbitrary differential of $5 per ton.

Now, arbitrary differentials are always the results of agreements or commands. The arbitray differential at Birmingham is concededly the result of a fiat of the U. S. Steel Corporation. How can that square with an "economic law of supply and demand" which imposes a differential that the mills so plausibly suggest must apply in the Chicago district, that differential being the amount of the freight from Pittsburgh to Chicago, now $6.80 per ton.

An economic law must apply equally to all sections of the country. That is admitted. The same kind of economic law should apply to all commodities, and certainly to all commodities of a related group. That must also be admitted.

Here is an "economic law" which does not apply alike to all sections of the country, nor to all commodities, nor to all commodities of a like group.

How can it be regarded as an "inexorable law" at all? Is there any escape from the conclusion that instead of being an economic law, immutable and inexorable, it is a device fixed by the steel mills themselves for the benefit of their own pockets solely?

It is true, as the mills assert, that during 1921 and 1922 "Pittsburgh Plus" was not in full force and effect in the Chicago district upon a considerable portion of the output of the mills. It went by the board, either in whole or in part, during this period, on plates, shapes and bars, which comprise the major portion of the mills' output of merchant steel. It is also true that this was a period of abnormal depression in the steel trade; that the mills fought for business among themselves, and therefore disregarded "Pittsburgh Plus." That is, there was a period of real competition among the mills.

This would seem to indicate that the contention of the mills that "Pittsburgh Plus" is abandoned in times of depression, when the Chicago district is able to supply its demand, is well founded.

But it is another remarkable feature in connection with the abandonment of "Pittsburgh Plus" on plates, shapes and bars in 1921-22 that these were the only products of the mills upon which this exaction was removed. It remained in full force and effect upon steel sheets, wire, nails and tubing, and the natural inquiry is prompted as to why these products were exempted from the operation of the so-called "law of supply and demand," when plates, shapes and bars accorded with it.

It is perhaps true that, even in this period, the Chicago district did not produce sufficient steel sheets and tubing to satisfy the normal demand in the Chicago market, although this is questioned. But there can be no doubt that the productive capacity of nails in the west was not only far greater than the demand at that time, but under normal conditions is always far greater than the western demand.

The total annual production of nails in the United States is about 12,000,000 kegs. The total western capacity to supply nails is approximately 7,250,000 kegs. There is no question that the west does not consume 60 per cent of the total production of nails, yet it has the capacity to produce that proportion, according to figures issued by the American Iron and Steel Institute.

With this capacity for production there can be no excuse for the imposition of "Pittsburgh Plus" upon nails, even according to the theory of the mills, and yet it is not only exacted, but even during the depression period it remained in full force.

What does this argue?

Certainly not the operation of the "law of supply and demand," because that does not apply. The real fact is that sheets, tubing, wire and nails are even more closely controlled than the general run of steel mill products, and despite the depression, the mills were, nevertheless, able to maintain the "Pittsburgh Plus" price on these commodities.

It is significant also, that steel nuts, bolts and rivets were never upon a Pittsburgh base until 1918, after the War Industries Board revoked its order, to which reference will be made a little later, establishing a Chicago base on plates, shapes and bars. This lasted eight months, and following the revocation of the order nuts, bolts and rivets were charged to the consumer with the "Pittsburgh Plus" added.

If "Pittsburgh Plus" is an economic law applicable to all products, then it should have applied to nuts, bolts and rivets prior to 1917. If it is not, it should not have applied after July, 1918, because there was no relative difference in the eastern and western production of these commodities in the eight months which elapsed from September, 1917, to July, 1918.

On the other hand, except for this period and for a few weeks in 1908 and 1914 respectively, and for eight months from September, 1917, to July, 1918, "Pittsburgh Plus" has been in full force and effect ever since it became a settled practice, which was practically coincidental with the formation of the U. S. Steel Corportion and its practical control of the steel industry, about 1901. It is absurd to say that these were the only periods of depression in the steel trade. That is not the fact, yet except during the 1921-22 period, the longest time in which "Pittsburgh Plus" was not in vogue on rolled steel was during the eight months of 1917-18. This last eight-month exception had nothing to do with economic law nor with the will of the mills. The steel pricing committee of the War Industries Board abolished "Pittsburgh Plus" on plates, shapes and bars, and established on these products a Chicago, base on a parity with Pittsburgh in September, 1917. At that time there was an implied understanding that

Continued on page 16

OIL HYDROGENATION

By
Herbert Sieck, '11

NATURE seems to have provided, especially in the temperate zones, an excess of liquid oils. Contrary to this provision, we living in this climate prefer the fatty portion of our diet in the solid or semi-solid form, such as butter, lard, solid cooking compounds and the like. Furthermore, on account of the large amounts of liquid oils available as compared with the solid fats, the prices of the former, as a rule, range below the prices of the solid fats. As a result much work has been done by investigators to devise a method whereby the liquid oils could be transformed into solid fats for human consumption as well as for technical purposes. The way for this achievement was first pointed out by Sabatier and Senderens, two French chemists, in about 1899, when they successfully hydrogenated oleic acid in the gaseous form, using nickel as a catalyzer. With this as an impetus more and more investigators entered the field. plants were established all over the world, and the industry placed on a firm footing.

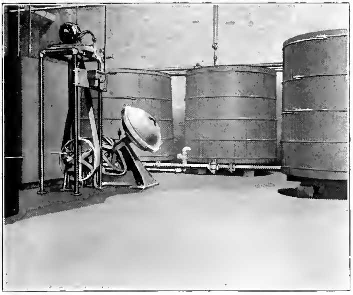

Figure 1

Oils and fats are mixtures of the neutral glycerides of the various fatty acids. The physical and chemical characteristics of the various fats and oil are, therefore, dependent entirely on the different proportions of the different glycerides which are present in the particular oil or fat. Some of these glycerides, as olein, are liquid at ordinary temperatures; others, such as stearine, have melting points around 70°C. Some are saturated with respect to addition products, others are unsaturated. The process of oil hydrogenation depends on the addition of hydrogen to these unsaturated glycerides. Olein, the tri-glyceride of oleic acid, and linolin, the tri-glyceride of linolic acid, are the most prominent members of the unsaturated glyceride group. Paradoxical as it may seem, the addition of hydrogen, a gas, to these tri-glycerides, both liquids at low temperatures, results in a solid fat, stearine, melting at 70°C. In the case of olein six atoms of hydrogen are required to satisfy one molecule of olein; in the case of linolin twelve atoms of hydrogen are required for complete saturation. In both cases the resulting product is stearine.

The addition of hydrogen to the tri-glyceride molecule is not quite as simple as it appears. The mere passing of hydrogen gas through the oil or melted fat, even at high temperatures and pressures, is without effect. There is no combination of the oil and gas. When, however, a minute quantity of catalyzer such as metallic nickel, cobalt, platinum, or palladium, is added the reaction proceeds rapidly to complete saturation. There has been much speculation as to the mechanism of this reaction, inasmuch as the catalyzer appears to undergo no change during the reaction. One theory explains the action as the result of a combination of the hydrogen with the catalyzer to form a metallic hydride, the reaction of this hydride with the tri-glyceride, with the resulting addition of the hydrogen to the tri-glyceride molecule and the freeing of the metal to repeat the process. Whatever may be the exact nature of the reaction, it is known that high pressures and temperatures facilitate the action, and that the speed of the reaction is proportional to the exposed surface of the catalyzer.

Practically all vegetable, animal, and fish oils are capable of being hydrogenated to a greater or lesser degree, depending on the proportion of the tri-glycerides of unsaturated fatty acids present in the oil. The index of the amount of unsaturated tri-glycerides contained in an oil or fat is found in the iodine value. Thus cocoanut oil, with an iodine value of 8.0 to 10.0, shows comparatively little change on hydrogenation, whereas cottonseed and linseed oils, with iodine values of 110 and 198, show a remarkable transformation.

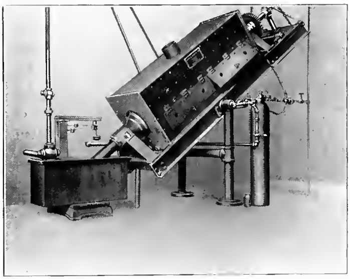

Figure 2

The hydrogen requirements for carrying out the hydrogenation process are large. For some oils one and one-half to two cubic feet of hydrogen are required per pound of oil. The average oil hydrogenation plant has a capacity of about 35,000 pounds of oil per day and, therefore, may require as much as 70,000 cubic feet of gas per day for continuous operation. On this account the source of hydrogen gas receives the greatest consideration in determining on the location of the hydrogenation plant.

There are four methods of hydrogen gas production for use in this industry. The first, and the one used in

the larger number of the plants in this country, is the electrolytic decomposition of water. As oxygen gas is a by-product of this method it is usual to operate hydrogenation plants in connection with oxygen producing plants, or *vice versa*. The large consumption of oxygen for cutting and welding metals affords a ready market for the disposal of the by-product oxygen. The hydrogen produced by this method is of high purity, the maintenance cost of the equipment is very low, and but little skill is required to operate such a plant. For large amounts of gas or in locations where the cost of electrical power is prohibitive two other methods are available. One, in which steam is passed over iron at high temperatures, results in the formation of hydrogen and iron oxide. The oxide is in turn reduced to metallic iron by passing water gas over the incandescent oxide, and the process repeated; or this process can be made continuous by passing a mixture of steam and water gas over an iron contact mass, and purifying the resulting mixture of gases to produce a gas suitable for hydrogenation purposes. The fourth method utilizes the by-product hydrogen produced in the manufacture of chlorine and caustic soda by the electrolysis of salt brine. Gas produced in this manner after suitable purification is being used in a number of plants in this country.

The process of catalyzer production and the hydrogenation of oils lends itself to many modifications. It would be impossible to go into the details of all of the different processes, and the following description will, therefore, be confined to a plant such as is installed by the writer and his associates.

The operation can be divided into the preparation of the catalyzer and the treatment of the oil with hydrogen in the presence of the catalyst. Nickel is the metal most generally accepted as a catalyst on account of its low cost and availability. A cheap source of nickel for this work is found in the commercial single nickel salts or nickel sulphate. This is dissolved in water in wood tanks (Fig. 1), and the nickel precipitated from the hot solution as the insoluble carbonate by the addition of sodium carbonate solution. The nickel carbonate, which is a heavy granular precipitate, is washed free of sodium sulphate either by decantation or in a washing type filter press. After the washing is completed a small quantity of kieselguhr is added, thoroughly mixed in, and the mixture dried in a steam-heated tray type dryer. The dry cakes from the dryer are transferred to a ball or globe mill, and ground to a fine powder. Inasmuch as the activity of the catalyst depends on the surface exposed, it is necessary to grind very finely to expose the maximum surface, and also to make possible the dissemination of the comparatively small percentage of catalyzer throughout the oil in the later steps of the process. The ground nickel carbonate is now ready for reduction in an atmosphere of hydrogen to produce metallic nickel. The apparatus used for this purpose consists of a horizontal revolving cylindrical retort, about six feet long by two feet in diameter, enclosed in a well insulated casing. Heat is supplied either by gas or by electricity. Provisions are made for introducing hydrogen into this retort and for the removal of the carbon dioxide and water vapor formed, during the reducing process. The operation is carried out at a temperature of about 800°F. Complete reduction of a charge requires about five hours and is indicated by the absence of water vapors in the escaping gases at the retort outlet. It has been found that the reduction of nickel salts alone results in a clinkering together of the particles, resulting in the formation of a heavy granular catalyst, comparatively inactive and difficult to hold in suspension in oil. The presence of the kieselguhr, added after the precipitation and washing of the carbonate, prevents this action. The reduced nickel in the retort is in a highly pyrophoric state, and must be removed from the retort without exposure to the air, to

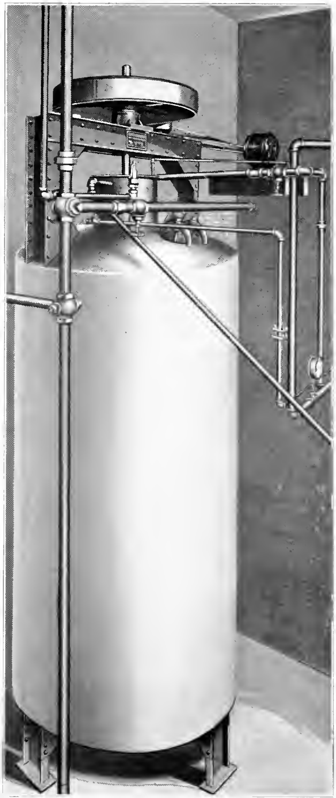

Figure 3

prevent oxidation and loss of activity. To accomplish this the residual hydrogen gas in the retort is swept out with an inert gas such as nitrogen or carbon dioxide, the cover plate on one end of the retort is replaced by a short section of pipe, and the retort tilted (Fig. 2) so as to submerge the end of the pipe in a small tank of oil. The further rotation of the retort discharges the contents into the oil, thus sealing the catalyzer against exposure to the air. The catalyst is now ready for intro-

duction into the oil to be treated, which is contained in the hydrogenation tank or "converter."

The "converter" consists of a vertical cylindrical steel tank, six feet in diameter and about fifteen feet high, and holding about 20,000 pounds of oil per charge. It is designed to operate at a pressure of 60 pounds per square inch. The converter is fitted with an efficient stirring device and a coil for heating or cooling the contents. From 1/20 to 3/10 per cent of the nickel catalyst, depending on the kind of oil to be treated, is pumped into the oil contained in the converter. The agitator is started and the temperature of the oil brought up to about 150°F., hydrogen gas being admitted at the same time through perforated coil in the bottom of the converter. A vigorous reaction sets in at once, and being strongly exothermic, there is an immediate rise in the temperature of the oil in the converter. The temperature is allowed to rise to 375 to 400°F., and is controlled at this point by circulating cold water through the coils of the converter. In the case of oils such as cottonseed, peanut, or corn, complete saturation with hydrogen can be accomplished in one and one-half to three hours. The progress of the reaction is determined either by noting the drop in pressure in the hydrogen storage tanks or by making melting point tests on samples drawn from the converter. As a change in the index of refraction of the oil takes place during hydrogenation the degree of hydrogenation can also be determined by taking refractometer readings on samples drawn during the operation.

The hydrogenation of the oil having been carried to the desired point, the oil is cooled to 300°F. and the catalyst removed by passing the oil through filter press fitted with cotton duck cloths. The clear oil is allowed to flow into storage tanks. The catalyst retained in the filter press is removed and is re-used in the next batch of oil to be hydrogenated. An important factor in the operation of a hydrogenation plant is the re-using of the catalyzer. Some oils contain catalyer "poisons," the action of which gradually reduces the activity of the catalyst until a point is reached where the reaction between the hydrogen and the oil will no longer go forward. Among others, the presence in the oil of moisture, soap from the refining process, sulphur and phosphorous compounds, and traces of solvents which may have been used in the extraction of the oil from the oil bearing seeds have a deleterious effect upon the catalyst. In most cases it is advisable, for the efficient operation of the plant, to pretreat the oil for the removal of these substances before hydrogenation. By such methods it is sometimes possible to re-use the same catalyzer from ten to fifteen times before it loses its activity. The nickel in the spent catalyzer is recovered in the form of nickel sulphate by leaching with sulphuric acid. After the plant is in operation the requirement for an additional supply of nickel from the outside is only such as is incurred through the mechanical losses in handling the catalyst in the plant.

Investigation has shown that the use of hydrogenated oils for edible purposes has no deleterious effects whatsoever on the human system. Large quantities are used as a substitute for oleostearine, an animal fat, in the production of solid cooking fats, known to the trade as "compound." Solid cooking fats can also be prepared by hydrogenated liquid oils, such as cottonseed oil, to a melting point of from 95 to 98°F. The vegetable margarine industry is also a large consumer of hydrogenated fats and oils. Fish oils, liquid at ordinary temperatures and possessing a decidedly disagreeable odor, can be hydrogenated to produce a white, odorless, and hard fat, suitable for soap manufacture.

NEWS OF THE NEW INSTITUTE

A great deal of concern has been demonstrated by the students as well as the public in general over the sale of the proposed site of the Greater A. I. T. All will be pleased to learn that this sale does not contemplate the discontinuance of the plans for a big new school sometime in the near future. The following letter sent by President Raymond to all members of the Alumni Association is assurance of that fact. It is gratifying to know that our most cherished hope is not to be abandoned:

"Newspaper announcements that the proposed new site of the Armour Institute of Technology has been sold by Mr. Armour does not mean that the Institute's building plans have been changed. Since Mr. Armour purchased the eighty-acre tract on the South Side, several years ago, values in that neighborhood have increased tremendously, and for all practical purposes the tract has become too valuable to warrant holding it vacant until such time as the Institute is ready to build. Accordingly the tract has been disposed of, but in announcing the sale Mr. Armour said:

" 'When we purchased this tract it seemed an ideal site for the building of a new Armour Institute of Technology, and while the time had not arrived for moving from the present quarters at Thirty-third and Federal Streets, it seemed a wise thing to purchase the land and hold it for the future. However, the community surrounding the tract has grown very rapidly, and property has increased in value to such an extent that the eighty-acre tract in the middle of it acquired value which made it an economic waste to hold it vacant for a number of years. Accordingly it has been sold.

" 'The Institute will not be the loser thereby. When conditions are propitious we expect to secure an equally suitable site to carry on the Institute's building plans.'

"With this hopeful assurance from Mr. Armour, I am sure the alumni will appreciate the wisdom of his action.

"Yours very sincerely,

"H. M. RAYMOND, *President*."

THE ARMOUR Y. M. C. A.

The outlook for a successful year for the Armour Y. M. C. A. is indeed an excellent one. The quarters have been changed, and plans are now being prepared which, if successful, will make the "Y" a more important factor in student life than ever before.

Doctor Sherger gave the first of a series of "Y" talks at the Association's rooms on October 30. Dr. Sherger's interesting Y. M. C. A. talks of last year are well remembered by all who heard them, but this year's series bids fair to be even better and more interesting.

A membership drive will probably be launched in the near future, and every student is expected to turn out and help give the "Y" the important place it deserves in our student affairs. But don't wait for the drive. See Shumacker, Schultze, Grube, or Johnson immediately.

FROSH FIRE PROTECTS BANQUET

A banquet was given by the Western Actuarial Bureau Scholarship Committee at the Union League Club on September 9 for the incoming class of Freshman Fire Protection Engineering Scholarship men. Mr. J. V. Parker, Manager of the Western Actuarial Bureau and Chairman of the Scholarship Committee, Professor Finnegan, and Mr. Nelson made short talks, informing the youthful banqueters concerning the opportunities offered by the course they will take, and the work included in the course.

"PITTSBURGH PLUS"

Continued from page 12.

the Chicago base would remain as a permanent factor in the steel trade, and as a result many new industries requiring steel located in the west and many of the older industries expanded.

This was largely because of war requirements. When the nation was seeking eagerly for war material in 1917 the west was unable to supply its needs because of the handicap imposed by "Pittsburgh Plus." It was that which caused the War Industries Board to remove this obstacle, as a result of which western industry immediately began to play its part in the supplying of the war requirements of the nation.

When "Pittsburgh Plus" was restored in 1918, the effect was not immediately felt. Most of the work done in plants using steel was for the government. A great deal of this was on a "cost plus" basis, and the price of material made no difference. That which was upon a contract basis then enjoyed prices which enabled the manufacturers to make a reasonable profit, since the government absorbed practically their entire output, and even where their product was sold to other purchasers the curtailment of general production, because of war needs, was so great that the prices obtained enabled the manufacturers to live and make a fair profit.

With the end of the war the situation changed notably. Manufacturers in the Chicago district then suffered from the effects of "Pittsburgh Plus," and sought to have the practice changed, without success. Those who had expanded during the war period, and those who had built new industries based upon their proximity to a source of low-cost steel supply, faced stark ruin.

For "Pittsburgh Plus," whether or not it exists by virtue of economic law, is a serious handicap to all industries outside of the Pittsburgh district, which use steel in large quantities.

That is plain enough. The Pittsburgh manufacturer has the whole country at his disposal for trade territory. He can compete everywhere upon at least an equal basis with any other manufacturer, no matter where located, even in the home town of a competitor.

In most places he is favored because through freights are less than the imaginary freight from Pittsburgh plus the actual freight from the point of manufacture to the point of destination.

The Pittsburgh manufacturer pays no imaginary freight. He pays only the actual earned freight upon his product, which, in practically all steel commodities, is the same as that upon raw steel. His competitor in the west pays the fictitious or phantom "Pittsburgh Plus" freight, and also pays the earned freight. Where there is a wastage in the manufacture of the product the Pittsburgh manufacturer enjoys a distinct advantage, even in the home town of a competitor, because he only pays the actual earned freight upon the finished product, while his competitor pays the fictitious freight upon the raw steel. This makes the cost of raw material of the western man greater than that of the Pittsburgh man.

This is a handicap which is severely felt in many lines, especially in building construction, farm implements and everything else in which the cost of steel is an important factor. As a result, the steel industry and everything dependent upon it has largely centered in and about Pittsburgh, despite the fact that the Chicago district, the Birmingham district, and possibly other districts enjoy greater advantages in lower-cost production and facilities for distribution. Inefficient mills are protected by this greater margin of price, and this is done at the expense of the ultimate consumer. As a result a number of organizations are up in arms against the "Pittsburgh Plus" practice, and have joined in litigation directed towards its abolition. Among these organizations are the American Farm Bureau Federation, the National Association of Purchasing Agents; numerous civic and industrial bodies in the west and south, and at least five sovereign states.

In the litigation referred to it is in evidence on the authority of one of the largest manufacturers of farm implements in the United States that because of "Pittsburgh Plus" the recovery of the agricultural districts from the recent depression has been notably retarded. This manufacturer stated, under oath, that the excess cost upon farm implements caused by "Pittsburgh Plus"—which was then almost 20 per cent of the cost of raw steel—was doubled by overhead, selling expense and added profits to middlemen by the time any implement reached the ultimate consumer.

James R. Howard, president of the American Farm Bureau Federation, testifying in the pending litigation, stated that the average American farm consumes over a ton of steel annually, and gave figures showing that in eleven western agricultural states the "Pittsburgh Plus" exaction takes a toll from farmers alone of over twenty million dollars a year. This amount, he estimated, would be more than doubled for the farmers of the entire country. His estimate was based upon the actual difference in the cost of steel entering any agricultural implement that was caused by "Pittsburgh Plus," and following the statement of the agricultural implement manufacturer, it is plain that the farmer when he buys his implements really pays about twice as much.

It has been estimated—and conservatively, it is believed—that the direct tax imposed upon the consuming public of the entire nation by the "Pittsburgh Plus" practice amounts to at least seventy-five million dollars a year. By the time the ultimate consumer pays this, with added overhead charges, middlemen's profits, etc., this amount is probably doubled, or nearly so.

What is its effect?

Plainly, it is a "protective tariff" for the benefit of one section and to the detriment of all other portions of the country. This tariff is not one which the congress of the United States imposes, but it is a seizure of the prerogative of congress by those in control of an industry, for their own benefit.

In fact, it lays an impost of several dollars a ton on steel—$6.80 in Chicago, and a great deal more in some other places—the purpose of which is to make those consumers who depend for their supply upon steel produced elsewhere than in the Pittsburgh district pay more for steel commodities, so that Pittsburgh may flourish.

This fact was shown strikingly during the 1921-22 period, when "Pittsburgh Plus" was abandoned in the Chicago market on plates, shapes and bars. At that time the Jones & Laughlin Company, of Pittsburgh, in order to meet western competition, installed a barge line upon the Ohio and Mississippi rivers. It advertised widely the economies resulting from the cheap water transportation thus afforded. Analyzed, however, it was found that the water rates to river points

made by the Jones & Laughlin company were only equal to the rail rates from Chicago. That is, the economies effected merely enabled the Jones & Laughlin Company's Pittsburgh mill to meet Chicago competition on an equal footing. When competition was unhampered and was upon a natural basis.

The lead of the Jones & Laughlin Company in installing barge transportation has been followed by the American Steel and Wire Company and the Carnegie Steel Company, of Pittsburgh, both subsidiaries of the United States Steel Corporation; the Wheeling Steel Company, of Wheeling, W. Va., and other producers in the Pittsburgh district.

The Jones & Laughlin Company has been advertising widely, calling upon people in the Mississippi Valley and elsewhere to insist that congress appropriate more money for the improvement of interior waterways, and calling attention to the economies in distribution which would result therefrom.

There is no question that distribution costs would be considerably reduced by cheaper water transportation, but if "Pittsburgh Plus" is again the general practice, the consumer will obtain no benefit, so far as steel is concerned. That is true because he will be charged the full rail freight from Pittsburgh, no matter where he buys his steel or what it costs to transport it. With "Pittsburgh Plus" in operation, the cost at any river point would be the mill price at Pittsburgh, plus the rail freight from Pittsburgh.

The mills would save money by water transportation, and this saving would go to swell their dividends. They would be promoting efficiency and economy of operation and of distribution, it is true, but the public and the country would derive no benefit from this saving.

Is it conceivable that the nation will sanction a domestically imposed protective tariff, dictated by a single industry for the benefit of one section only, and will also permit the billions of dollars contemplated to be spent in interior waterway improvement to go for naught except the providing of additional profits for the same group in control of steel which has already usurped a governmental function? Because of these factors, "Pittsburgh Plus" has entered the arena of politics in the west and south, and many public men are actively engaged in the effort to put an end to the practice. The agricultural bloc in congress is committed against it. The Progressive Republican platform of Wisconsin contained a strong plank against it. It played a part in the Republican primary in Iowa. The legislatures of Minnesota, Wisconsin, Illinois, Iowa and Missouri and the senate of Georgia have adopted resolutions condemnatory of the practice, and several of these states have instructed their attorneys general to intervene in the pending litigation. I have made reference several times to this litigation. It started in 1919, when western manufacturers, after fruitless efforts to prevail upon the mills to settle the dispute through friendly meetings, finally, at the suggestion of Judge Gary himself, brought it to the attention of the Federal Trade Commission. After long arguments the commission first refused to issue a complaint directed against this practice. This action was taken by a vote of three to two. Application was made for a rehearing by the Western Association of Rolled Steel Consumers, the organization of western manufacturers which started the litigation, and a year later, in December, 1920, argument was heard upon this application. On April 30, 1921, the commission reversed its former finding and issued a complaint. The taking of testimony was begun on January 30, 1922, following a considerable preliminary field investigation by the commission's investigators and attorneys. Hearings have been held intermittently ever since that time. The first hearings were held in Milwaukee, and were followed by sessions in Minneapolis, Chicago, Duluth, Chattanooga and Washington. It is expected that they will also be held at Pittsburgh before the case against "Pittsburgh Plus" is completed. Following its completion, the respondent, the United States Steel Corporation, will put in its defense, and further hearings covering a considerable period of time are likely.

If "Pittsburgh Plus" is abolished, it will probably mean that Chicago will soon become the steel center of the world. Admittedly the lowest cost point of production in the United States and the best situated distributing center, it is even now the second largest steel producing district.

Investments aggregating, according to apparently reliable estimates, well over two hundred million dollars are awaiting the abolition of "Pittsburgh Plus" in the Calumet district, embracing a large part of South Chicago and the steel towns of northwestern Indiana, in which most of the steel in the Chicago district is produced.

It is conceded that a number of Pittsburgh mills and Pittsburgh steel industries must build factory plants in the Chicago district to conserve their western trade if "Pittsburgh Plus" goes by the board.

This was admitted by the Jones & Laughlin Steel Company, of Pittsburgh, in its answer filed in the pending litigation, in which it asserted that 30 per cent of its product is sold in the west. It made this an argument to support the contention that Chicago could not produce steel enough to satisfy its demands, but ignored the fact that all of the mills in the Chicago district ship part of their product east, which, by parity of reasoning, would argue that Chicago produces more than it requires for its own consumption.

Further, the Jones & Laughlin Company stated that "the only result of the abolition of 'Pittsburgh Plus' would be the tearing down of industry in Pittsburgh and the building up of Chicago." This company apparently overlooked the fact that if Chicago is the point of most economical production, then efficiency and economy in production demand the upbuilding of the steel industry there, even at the risk of tearing it down to some extent in Pittsburgh.

Efficiency and economy do not take account of the sanctity of existing investments. Factory equipment is ruthlessly junked to satisfy the demands of greater efficiency and greater economy. If the nation is to prosper as it should, and lead the world in industry, it cannot consider the safeguarding of any single investment or group of investments, but must consider only the welfare of industry as a whole.

These are considerations which inexorably point the way to the necessity of the adoption of such expedients in the future as will diffuse industry over the country in the widest possible fashion; will cause it to be placed upon the most economical and efficient basis, and will, in the greatest possible measure, serve the needs of the entire nation rather than the desires of any group in control of any single industry.

COLLEGE NOTES

On May 23, 1922, Dr. Howard Monroe Raymond was elected to the Presidency of the Armour Institute of Technology. In this first issue of THE ARMOUR ENGINEER *since he has assumed that high office we wish to express our appreciation for the sympathy, encouragement and co-operation which he has so generously given us.—The Staff.*

Mr. Edwin Fraser Gillette '06 represented the Armour Institute of Technology at the inauguration of Dr. R. B. Von Klein Smid as President of the University of Southern California on Friday, April 28, 1922, at Pasadena, California.

Mr. Harold Ralph Badger '08 represented the Armour Institute of Technology at the dedication of Foster Hall on the Campus of the University of Buffalo on Friday, October 27, 1922, and on the following day Mr. Badger represented the Armour Institute at the inauguration of Samuel Paul Capen to the office of Chancellor of the University of Buffalo.

The latest addition to the faculty comes to us in the person of Mr. F. W. McClusky, of the English Department. Mr. McClusky is an experienced educator, having been for a number of years Principal of Union Academy, and later Dean of Blackburn College, Carlinville, Ill. Immediately prior to his appointment to the faculty Mr. McClusky held the position of Instructor in Social Science and English at Central Y. M. C. A.

In addition to his duties in the English Department Mr. McClusky is a Departmental Superintendent, Chicago University Library, and last, but by no means least, leader of the A. I. T. Orchestra.

Editor's Note:

Mr. E. J. Buffington, President of the Illinois Steel Co., has been kind enough to furnish THE ENGINEER with a letter setting forth a number of arguments tending to show that the "Pittsburgh Basing Plan" is a function of the normal operation of the immutable laws of supply and demand. It is regretted that this letter was not received in time for publication in this issue of THE ENGINEER. However, its publication in our next issue is assured.

RECOMMENDING ADOPTION BY ALL ARMOUR STUDENTS

A pledge drawn up for "Good English Week" includes the following:

1. I will not dishonor my country's speech by leaving off the last syllables of words.

2. I will use a good American "Yes" and "No" in place of an Indian grunt, or a foreign "ya."

3. I will do my best to improve American speech by avoiding loud, rough tones; by enunciating distinctly and by speaking clearly and concisely.

SCHOLASTIC STANDINGS

The following statistics, compiled by the office of the Deans, give the scholastic standings of the members of the Freshman, Sophomore, and Junior classes of the College of Engineering and Architecture who were in attendance during the second semester of the school year 1921-22. In this computation the grades in physical training were omitted. A credit, either for work at the Armour Institute of Technology or for work elsewhere, was considered equivalent to a grade of "B."

The average of the entire school body (Seniors omitted), a total of 535 students, is 86.1 per cent.

The averages of the various organizations are as follows:

Junior Class	87.6 per cent
Sophomore Class	86.6 per cent
Freshman Class	84.5 per cent
Mechanical Engineering Department	86.7 per cent
Electrical Engineering Department	86.2 per cent
Civil Engineering Department	85.3 per cent
Chemical Engineering Department	86.8 per cent
Fire Protection Engineering Department	86.8 per cent
Architectural Department	82.9 per cent
Industrial Arts Department	85.5 per cent

The Honorary Fraternities:

Tau Beta Pi	90.9 per cent
Phi Lambda Upsilon	91.3 per cent

Social Fraternities and Clubs:

Phi Kappa Sigma	86.3 per cent
Delta Tau Delta	84.8 per cent
Theta Xi	85.8 per cent
Sigma Kappa Delta	84.5 per cent
Beta Phi	84.9 per cent
Sigma Alpha Mu	87.2 per cent
The Pyramid	87.8 per cent
Scroll and Triangle	87.9 per cent
The Scarab	84.2 per cent
The Sphinx	89.3 per cent
Honor "A" Society	86.1 per cent

The average of all students belonging to the Phi Kappa Sigma, Delta Tau Delta, Theta, Theta Xi, Sigma Kappa Delta, Beta Phi, Sigma Alpha Mu, and Scroll and Triangle is 85.8 per cent. The average of all other students is 86.3 per cent.

In the above, the following numerical values were given to the letter grades: A=97.5%; B=90%; C=80; D=67.5%; E=50%.

Registration First Semester 1922-23

	SENIORS	JUNIORS	SOPHOMORES	FRESHMEN	SPECIAL	TOTAL
Mechanical	47	38	39	53	2	179
Electricals	25	41	49	60	.	175
Civils	26	39	23	35	1	124
Chemicals	15	23	31	17	.	86
Fire Protects	7	20	27	19	.	73
Architects	12	18	15	39	1	85
Industrial Arts	..	..	1	2	.	3
TOTAL	132	179	185	225	4	725

Noah was 600 years old when he built the ark. Don't lose your grip.—Elbert Hubbard.

ASSOCIATE PROFESSOR JAMES C. PEEBLES, *Editor*

THE first number of the *Armour Alumnus* published by the Alumni Association of the Armour Association of the Armour Institute of Technology, made its appearance about October 15th. Its purpose, as set forth in the initial number, is to provide a means whereby the members of the Association may be kept informed of the activities of organization, and thus in turn promote a more active interest on the part of all Armour men. Many have felt that the Alumni Association is not what it should be, largely perhaps, because the members have lacked adequate and timely information in regard to its affairs. This lack the *Armour Alumnus* is designed to supply, and judging by the first number, it will go far towards producing an active and influential organization, such as all loyal Armour men desire it to be.

The subject of chief interest before the Alumni Association at present is, of course, the campaign for the raising of a maintenance fund. The goal set is $50,000, which it is felt is the minimum endowment fund which will supply an income sufficient to support the necessary activities of the Association. It is proposed to establish a permanent office in the business district of Chicago, in charge of a paid secretary, which will serve as a clearing house for all educational and business information of interest to Armour men.

The *Alumnus* reports that out of a total Association membership of approximately 1,500 graduates and 7,000 non-graduates, subscriptions have been received from 176 men. The total amount pledged is $10,365.68, an average of $58.89 per subscription. In view of the comparatively small number of subscriptions in proportion to the total membership, it seems that many more should be secured. An immense amount of time and labor is required to bring such a proposition personally to the attention of each graduate and former student. To minimize this labor each Armour man is urgently requested to consider seriously what he can do in furtherance of this worthy object, and send in his subscription without waiting for a personal solicitation.

The first alumni luncheon of the present season was held Tuesday, October 24, at the Hamilton Club, Chicago. The occasion was of more than usual interest, due to the presence of Dean Monin, who has recently returned to the Institute after a year's absence in Switzerland and other parts of Europe. Dr. Monin told of his trip abroad, and of the familiar scenes which he visited. He expressed his pleasure, however, in being back at the Institute, a pleasure which is shared by all Armour men, past and present. Dean Monin appears to be very much improved physically over what he was a year ago, and it now seems assured that the students will enjoy his mature advice and kindly philosophy for a long time to come.

These luncheons will be a regular feature of alumni activities, being held on the second and fourth Tuesdays of each month, October to April, inclusive. The place is the Hamilton Club, and the hour 12 o'clock, noon. It is hoped that every Armour man will make a special effort to attend those get-together luncheons. Get away from the regular routine for once, and meet again some of the fellows whom you knew in your student days. It will revive your interest in the Institute and in the Alumni Association, and make you feel that you belong to a group of college men with a definite purpose and with the ability to realize that purpose.

Bradley S. Carr, '15, is Manager of the Pump Department of the American Manganese Steel Company, Chicago Heights, Ill. His specialty is dredge pumps, an industry which within five or six years has grown from practically nothing to its present status, where it is recognized as one of the leading methods for the excavation of materials where water is available. The dredge pump is a type of mechanical equipment about which there are very few data in the literature of mechanical engineering. Mr. Carr is at present collecting a valuable body of data on this interesting subject, and we hope to be able to present some of it in the near future in the columns of the ENGINEER.

Mr. Carr will doubtless be remembered by all graduates since 1915 as the author of the model thesis. This thesis was kept in a convenient place in the library, where it was readily available for examination by the members of the Senior class when they were writing their theses. Mrs. Beveridge took great pride in it, and advised the students to emulate it in orderly and logical presentation of the subject matter.

H. W. Nichols, '08, will be remembered as an instructor and assistant professor in electrical engineering at the Institute. He left Armour in May, 1915, to take charge of certain experimental and research work for the Western Electric Company in their New York laboratories. He has had much to do with the development of the radio telephone, much of the experimental work having been done under his direction. Last spring an interesting demonstration took place when the captain of the S. S. America, 400 miles at sea, con-

versed with the president of the American Telephone and Telegraph Company at his home in Canaan, Conn., by radio telephone. This demonstration was largely the outcome of work carried on by Mr. Nichols and his associates. Thus an Armour man makes a valuable contribution to the store of human knowledge and its application to commerce and industry.

J. A. Keeth, '19, is Assistant Superintendent of Production, Kansas City Power and Light Company, Kansas City, Mo. He has recently been substituting for his chief on the Prime Movers Committee of the National Electric Light Association. All engineers interested in power plants or central stations are familiar with the excellent work being done by this committee. In acting on this committee Mr. Keeth is in touch with the very latest developments in power plant practice, and is aiding in the collecting and publishing of a vast amount of engineering data for the information and guidance of power plant operators.

O. R. Prescott, '04, has been associated for some time with the Folwell-Ahlskog Company, Chicago, engineers and contractors in industrial plant work. Their business has developed extensively in the direction of the by-products coke oven, a subject to which Mr. Prescott has devoted much attention and special study. In spite of close attention to an exacting business Prescott seems as young as ever. Perhaps a vacation each year with rod and reel, to which he has always been devoted, explains why the years affect him so lightly.

C. T. McDonald, '04, has been in the electrical manufacturing business for about ten years. He is manager of the Multi-Electrical Manufacturing Company, and has just recently moved his business into new and larger quarters at 1848 West Fourteenth Street, Chicago. The company's principal lines are electrical wiring devices and conduit fittings. Members of the class of '04 will remember "Mac" as one of the team of McDonald and Strang, who used to make fierce concerted attacks on Johnson's Theoretical Mechanics.

G. W. Borst, '04, is now in the printing business, a line in which he had had considerable experience before coming to Armour. He is associated in a selling capacity with the Charles E. Tench Printing Company, 712 Federal Street, Chicago. "Bill" reports that the old slide rule works just as well in the print shop as in engineering or drafting work.

Graduates and former students who were in attendance at the Institute in 1909 may recall a quiet, slender youth who spent all his spare time in the boiler room, coming out for air and light only at rare intervals. The youth was I. H. Wilsey, who was engaged in developing several ideas for boiler room and other specialties, upon which he later secured patents. Wilsey spent more time in the Institute power plant than in the class rooms, so that perhaps only a few students of those days will remember him.

In the years since leaving Armour he has continued to exercise his inventive faculty, but has changed his field from steam to automotive specialties. Within the last year he has developed and perfected no less than three automotive specialties, one of which is already on the market. The others are at present in the hands of capable manufacturers who will soon have them ready for quantity production.

Mr. Wilsey is a frequent visitor at the Institute, where he is well known to many of the professors and students. He and Professor Gebhardt have become quite intimate, and nearly every morning at 9 o'clock a beautiful Lincoln sedan stops in front of Machinery Hall. Professor Gebhardt steps out, and Wilsey drives on to his experimental shop and laboratory on Wentworth Avenue. In the evening the Lincoln is there again, and the two drive back to Rogers Park, discussing on the way the relative merits of sleeve valve and poppet valve, or inertia stresses in crank shafts at high speed.

FIRE PROTECTION SOCIETY

The first meeting of the Fire Protection Engineering Society was held September 21. The election of officers for the year resulted in the following men gaining office:

O. L. Cox..*President.*
R. M. Beckwith............................*Vice-President.*
E. E. McLaren....................................*Secretary.*
R. O. Matson......................................*Treasurer.*

This year marks an epoch in the history of the Society. Until the present time the F. P. E. Department has had fewer students than most of the other departments in the Institute. Now, however, the number of men taking this course is rapidly increasing, and therefore the opportunities of the Society are becoming more numerous and of large proportions. Before, the Society was composed of merely a handful of members, but with the entrance of the Class of 1924 into its third year the active group, the Juniors and Seniors, has been greatly reinforced; hence the organization can begin to work on a larger scale.

The newly elected President, Mr. Cox, is well aware of the new opportunities. In fact, he spent a good part of the meeting in enumerating the activities which will be added to the usual program of events. Among these is the prospect of a big department smoker. A system whereby the members can exchange their practical experiences gained while working during the summer was suggested, and will, no doubt, enter the schedule. Then there were several other ideas that were brought up that are not developed enough to mention as yet.

The original purpose of the Society, however, was not overlooked while these new plans were being discussed. This primary purpose is to obtain prominent men in the Fire Protection and Fire Insurance fields for lectures on their particular specialties. Professor Finnegan is chiefly responsible for the speakers who visit us. Mr. Eppich was appointed to assist the professor this year by taking care of the part of this work that can be handled by a student representative. The Society is now looking forward to the first lecture because it is confident that the taste it acquired last year by hearing men of high calibre will be satisfied.

These few remarks lead to the most important object of this article, which is to tell the people connected with Armour Institute that the Fire Protection Engineering Society is beginning to expand, and that its members wish to announce to everyone in general this: "We're off!"

ATHLETICS

OUR ATHLETIC PROGRAM

By

JOHN J. SCHOMMER, *Director of Athletics*

THE salient feature in the athletic line this year was the formation of the Armour Tech. Athletic Association and Student Union. Thru its auspices and with the hearty consent and co-operation of the executive council, a great forward stride was taken in the promotion of sports for the purpose of physical development.

The writer, along with his other duties, was made athletic director and the following assistants were secured to develop the following sports:

Professor C. A. Tibbals will develop tennis at Armour and pick a small squad from which men of ability will compete with the surrounding universities. Four tennis courts will be built in the spring at a cost of $1,000. Professor Tibbals has in his charge this Fall a squad of 60 men who answered his call for tennis material.

Professor H. R. Phalen, formerly captain of the Tufts College track team, has the track material under his supervision. The development process was begun in October. A class meet was held and some good material for the track team was discovered. As the material shows promise and is developed, it is the intention to have our stars compete in the Western Conference, the Drake Relay Games, and the Relay Race Carnival at the University of Pennsylvania.

Swimming is a new sport to be developed here. Arrangements have been made to permit our candidates to practice at the tank belonging to the University of Chicago. The famous Coach White will have the men in charge.

Boxing and wrestling are also to be developed. Plans are afoot to develop teams in these sports to compete with the surrounding universities. The teams are to be in charge of Joe Smith, who is a former amateur and professional champion.

The golf squad is to be in charge of Professor C. W. Leigh. A golf squad was organized last spring and played several games with the universites of Chicago and Northwestern. The game was put on a firm basis when Professor Leigh was secured to develop the team and no doubt our competitive schedule will be enlarged.

Leo Walsh, our successful baseball coach, has been retained to again coach our baseball team in the spring.

Wm. C. Kraft will have the basket ball team under his charge. A squad of 50 to 60 men have reported and are busily working every night on our small crowded gymnasium floor.

The question of football for Armour Institute has been agitated for years. It has been petitioned for, dreamed about and yelled for. This past spring, the Board of Athletic Control appointed Mr. Mundy, President of the Armour Tech. Athletic Association and Student Union, Mr. E. E. McLaren, Professor P. C. Huntley, and the writer, to thoroughly study the situation as it is encountered at other institutions. This report will be ready probably next spring.

TENNIS.

AFTER a lapse of several years, tennis is again coming into prominence. At the beginning of the year it was announced that the Athletic Board of Control had asked Professor Tibbals to act as coach for the tennis team and that he had accepted this position.

In order to facilitate the selection of a team, a Fall Tennis Tournament was scheduled. The popularity of this sport was shown by the ready response of forty-eight entries, who displayed a fine spirit all through the tournament. The matches were played off as scheduled with only one or two defaults. The semi-finals and finals were played at the Winnetka Tennis Club in which "Gerry" Schumacher defeated Springer and Fuentes. His steady playing won over the somewhat erratic playing of his opponents and as a prize a silver cup will be presented him. A smaller cup will go to Fuentes as runner up. Coach Tibbals is very pleased with the results of the tournament and has passed his opinion that the class of material for a tennis team is high enough to place Armour on a level with Conference Universities. In the spring a small team will be picked which will be matched against some of the best college teams in the country.

Through the efforts of Athletic Director Schommer and Coach Tibbals, funds were appropriated for the construction of four "composition" courts behind the Armour Flats. The students have reason to be grateful for this, especially when they realize that as far back as 1903 agitation was started along this line. The construction of these courts will be started as soon as possible in the spring.

The selection of Coach Tibbals is a fortunate one as he has been a tennis enthusiast, as well as an expert player, for many years. This thorough knowledge, gained through contact with some of the best players in the country, cannot fail to be of great value to those who are fortunate enough to become members of the Armour Tennis Team.

TRACK

WITH the idea of discovering the quality and number of track men at Armour, Coach Phalen organized a Fall Track Meet. As all of the participants had had little or no training it can easily be imagined that no records were broken. This meet was primarily between the Freshman and Sophomore classes, although there was an all-class relay race. Just before the Christmas holidays an indoor meet may be run if a suitable place can be found and this meet will be between all the classes.

To build up a successful track team takes years of hard and unending training, so that the problem confronting Coach Phalen of producing a track team in six months is no small one. His plans are not to develop a well balanced team of track and field men but to specialize in those events for which there is an adequate amount of material. If a mile relay team can be developed by next spring, they will be sent to the Drake Relays and also the Penn. State Relays. The whole track team will probably be sent to the Western Conference Track Meet and also against other colleges.

Track can be made a successful sport at Armour if the students support it and turn out for the team, as it is practically the only major sport which can be indulged in without the presence of the entire team. It is a matter of individual practice and training. Thus, if a man has one or two hours off in the morning he can get as good a workout on the track as he could in the afternoon with all the team out. It is often found that among men of mediocre or undeveloped track ability, that there is a tendency to think that a track meet is won by the individual stars and that therefore their efforts are of little importance and are not appreciated. There has been very few men who could win a track meet by their own efforts, for the man who sets the pace or comes in third is just as important in winning the meet as the man who breaks a record.

BASKET BALL PROSPECTS

AT the first signs of cool weather this Fall, Coach Kraft issued the initial call for basket ball men. The results were quite promising as about forty-five men reported. Besides practically all of last year's team there seems to be a considerable amount of material in the Freshman Class. Pre-season forecasts are very uncertain indications of a team's future, but after the first three weeks of practice it is safe to say that Armour will be represented by a team that any school might be proud of.

Last year's letter men, who are again out for the team, are: Johnson, guard; Schumacher, forward; Spaid, center; and Ed. McLaren, guard and captain. The class games have brought to light some of the material in the Freshman Class which seems to be mostly of a forward nature as guards seem to be rather scarce.

Al. Danziger, Joe McLaren and Ed. Peterson have already shown up as fast forwards, while Terry and Gaylord are making strong bids for the center berth.

At the first of the year attempts were made to secure the Seventh Regiment Armory on the corner of Wentworth Ave. and 35th Street as a gymnasium. This was finally accomplished and the feat brought considerable joy into the office of Coach Kraft, as it has long been understood that Armour teams were greatly handicapped by a small floor. However, at a meeting of the State Legislature, it was decided that the floor should be torn up and a tan bark floor substituted. This was quite a blow to the players as well as the Athletic Department. Investigation was immediately started on the cost of installing a portable wood floor, similar to the one in Patten Gymnasium at Northwestern University. It was found that this would cost in the neighborhood of $3,200.00, which could be divided between the Knights of Columbus, who also play in the Armory, and Armour Institute; or might possibly be built by the Armory and rented to the two teams. The matter is still undecided and several other armories are being investigated as possible basket ball floors.

The schedule for this year is not completed, but a general idea of the class of teams played may be gathered from below:

December 8—Crane College at Chicago.
December 15—Marquette University at Armour.
January 4—Notre Dame at Armour.
January 12—Western State Normal at Armour.
January 15—Notre Dame at South Bend.
January 26—Bradley Polytech. at Peoria.
January 27—Augustana College at Rock Island.
February 9—Western State Normal at Kalamazoo.
February 10—Detroit University at Detroit.
February 12—Michigan Aggies at Lansing.
February 16—Augustana College at Armour.
February 24—Marquette University at Milwaukee.

Chicago University will probably be played immediately after Christmas vacation. Other games are tentative, including one with Northwestern University.

THE ARMOUR TECH. ATHLETIC ASSOCIATION

For the information of the Freshmen in particular and the rest of the student body and the alumni in general, we are presenting here a general outline of the organization of the Armour Tech. Athletic Association and Student Union which, devoid of complicating details, may be clearer than a more extended explanation. The following are extracts from the constitution:

Article I. Name

This organization shall be known as the Armour Tech. Athletic Association and Student Union.

Article II. Object

The object of this organization shall be to develop a unified Armour spirit by

1—Organizing and systematizing all inter-class relations, all class customs and privileges;

2—Serving as a means of communication between the student body and the faculty;

3—Investigating and rendering opinions upon any matter brought to the organization or upon any matter which may be initiated by the organization itself;

4—Passing and enforcing such acts as it may deem advisable for the government and regulation of the student body, providing that such legislation is approved by the Executive Council of the Institute;

5—Acting as a court of appeal from all sections of classes, members of committees in carrying on class activities, organizations, athletics, or any student;

6—Having full privilege of investigating the management of any student activity;

7—Fostering mass meetings at appropriate intervals;

8—Promoting inter-fraternity contests;

9—Stimulating interest in athletic events;

10—Assisting the athletic department in arranging schedules, receiving and caring for visiting teams, etc.;

11—Providing cheers and cheer leaders;

12—Directing and managing all matters which properly fall under the direction of such an organization.

Below is a diagrammatical outline of the organization showing the relation of the different officers:

Executive Council
Board of Athletic Control
Composed of:

Executive Council	Three Faculty Members	Officers of Athletic Association	Freshman Class Representative

President
H. W. Mundy

1st Vice President	Secretary	Treasurer
E. E. McLaren	G. P. Ruddiman	G. S. Allison

2d Vice President
M. H. Westerberg

Inter-Class Manager	Inter-Frat'y Manager	Reception Committee	Social Chairman	Publicity Manager
F. A. Hess	J. S. Farrell		O. L. Cox	E. R. Hubbell

INTER-CLASS ACTIVITIES

As has been the custom for several years, an outdoor indoor baseball schedule was played between the classes. These games are for the purpose of furnishing merriment to the spectators and as the Seniors seemed the most adept, they won the championship. In basket ball the Freshmen produced a combination that could not be stopped and simply had things their own way. The game with the Sophomores is considered as being one of the best class games ever played by class teams. Go to it, Freshmen, and send some of your men to the Varsity.

SIGMA ALPHA MU

In February, 1922, the Armour local fraternity which had existed for seven years as the "Ohr" became Sigma Epsilon Chapter of the Sigma Alpha Mu fraternity. This step marked the consummation of seven years of constant progress, and the beginning of a new period of further progress.

Sigma Alpha Mu at Armour inaugurated itself socially with a smoker held during April. This was followed by a formal dinner dance at the Hotel Ambassador late in May, thus closing the school year very pleasantly. During the summer the fraternity continued its social activities, which included a picnic in June, a boating party during July, an informal dance in August, and a final smoker in September, just before the reopening of school.

The school year of 1922-23 was begun with a burst of enthusiasm. Fraternity quarters were acquired and furnished. An alumni smoker was held early in October. Five men were pledged during November. An informal dance was held at the Sheridan Plaza on November 19th.

Very extensive preparations are now being made for the 1922 National Convention to be held in Chicago, December 29, 30, 31 and January 1 inclusive.

DELTA TAU DELTA

Hello! Hello! Hello!

We have resumed our duties at the Institute and everyone seems pleased with settling down to work.

The Chapter started the college year with twenty active brothers, each of whom is assiduously at the task of establishing the fourness of two and two.

Rushing was allowed only during the month of October and the activities of that month have given us nine pledges of exceptional calibre.

Our social calendar for the college year has included a house dance, a football game and a smoker, each of which were enjoyable and appreciated affairs. We are anticipating though the most brilliant affair of the season in the Delt Prom and at the same time we have the incomparable Doctor Weilands dinner appetizingly enticing the brothers and pledges.

"We live in a house by the side of the road," and won't you all stop by?

THE "FROSH" FROLIC.

In the large universities, where work is not allowed to interfere too much with pleasure, the Freshmen are welcomed by the upper classmen and made to feel as though they "belonged." Some of the freshness is promptly taken out of them by the Sophomores, who themselves have just emerged from the embryonic state, by drubbings, tubbings, etc., provided, of course, the Sophs are always present in sufficient numbers. To hasten and facilitate his acquaintance with the upper classmen, the Freshmam is usually required to wear a tiny green cap, which immediately places him in the public eye and assures him of recognition on the campus.

The Freshman at Armour, however, longs in vain for such manifestations of good will. He finds everybody busy, very busy, and usually, much to his surprise, he soon finds himself very busy. He is likely to go about his business "unheralded and unsung" and finally lose his identity in the maze of Reid's drawing and college algebra. To guard against such a contingency we have the Frosh Frolic.

It is here that the new man is given a chance to make his presence felt. Instead of making him wear a ridiculous green cap we invite him to appear at his best, with plenty of time to prepare. He is allowed to place himself in the public eye under ideal conditions, and is it any wonder that there is always a wild scramble for a place on the program? It is the Freshman's night and he reigns supreme. So, Freshman, it is up to you. Polish up your talents and let's show the present Sophomores that they're not so good, even though they did put on a pretty good show last year.

The Frolic is being fostered this year by the Athletic Association, and is in charge of the Social Chairman, while Mr. Joseph, of the Junior class, is to be the Director in immediate charge. The time has not been definitely decided upon, but it will probably be held the second or third week of December. We want suggestions and help from everybody on stunts, sketches, etc., and we want a lot of volunteers from the Freshman class. We must have a good clean show, with no rough-house by the upper classmen. With these limitations, we have the approval and enthusiastic support of Dr. Raymond and the Dean's office.

O. L. Cox, *Social Chairman.*

WILL YOU NEED A JOB?

When your school days are finally over and you have packed away your Calc. book and sundry others in moth balls or cold storage—when you have discarded the role of a student and assumed the role of an engineer, and your thoughts have turned toward obtaining the wherewithal to purchase bread-and-butter and movie tickets—are you assured that there will be a position awaiting you? Will it be in the line of work in which you are most interested? Will it be in importance and in remuneration all you are capable of?

The Alumni Association can help every Armour man to answer the above questions in the affirmative. The Alumni Association maintains an office and a salaried officer, a part of whose duties is to assist Armour men to secure positions, and to secure Armour men for employers who need responsible engineers. In this way a newly graduated engineer has all the influence and reputation of the Armour Alumni Association to aid him in securing the position for which he is most fitted.

Our "new dress" is an indication of the marked change which has come over THE ARMOUR ENGINEER. Henceforth it will be our policy to devote a much larger space to the subject of Student Activities, which, together with Athletic News, Organizations News, and other items of a news nature and primarily of interest to students, will constitute practically one-half of the entire subject matter.

This does not mean that THE ENGINEER is to lose its valuable technical character, nor yet a large amount of space properly devoted to matters of Alumni interest. We do not aspire to all the severity of style of the "Atlantic Monthly" nor to all the artistry of "Country Life," nor yet to the popularism of a country local. What we do propose, however, is by a judicious combination of the desirable characteristics of all, to evolve a periodical which will at once furnish articles of a current technical character suitable for study or reference, and current personal news, jokes, locals, pictures, cartoons and other recreational matter—and which will combine the functions of an organ of the alumni, and a means of bringing individual students, groups, associations, classes, societies, and departments, into a more compact and unified whole, for the good of all and the glory of the Alma Mater.

To fulfill this remarkable program the co-operation and active assistance of each and every one of our readers is absolutely necessary. Do you want THE ENGINEER to be worth while and a credit to the Institute? Do you want to get your money's worth out of it? Then put your shoulder to the wheel! Personal items of an intimate nature, jokes of a personal nature or otherwise, cartoons and pictures of familiar or interesting objects, ideas, criticisms, and suggestions, are all needed. See how good your name looks in print! If you possess any interesting facts or ideas not common property, write them down and submit them. Your classmates, your fraternity brothers, and your friends, will all be interested to read something by you or about you. If you have a criticism or a suggestion, bring it forward. You are owner, publisher, and reader of this magazine, and its success depends entirely upon your support. Turn to, and in the light of the new era which is dawning upon the Armour Institute of Technology, give THE ENGINEER the success which your interest and support is giving all other campus activities.

IRA PETTIBONE—OPTIMIST

I

What's this talk about the old times, an' the days thet use ter be;
When things is runnin' smooth an' prime, ez fer ez I kin see?
I may be a little balder, an' the furrows on my brow
May be a little deeper—an' I stop more, I'll allow—
But my heart's ez young an' gushin' ez a sprightly yearlin' colt,
An' on the good things here below, I hev ez good a holt
Ez when I sparked my Tilly Ann, in the fall of sixty-three,
An' she sot on a split-rail fence, and gave her heart ter me.

II

What! Them times betterer than these? It's all a lot of trash.
I can take thet doctern out and smash it all ter smash.
Let the years pile on yer body old, but allus try ter keep
The spring of love a-gushin'; so the sun can allus peep
'Way down into your very soul, where joy is bidin' there—
The thing thet puts to grief old age's dread dispair.
Don't bow down to things 'at's past, old wrinkles an' grey hairs—
And the path 'ill be smooth an' easy, thet leads ter the golden stairs.

—*Wallace Bruce Amsbury.*

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(Signed) LESTER E. GRUBE.

Sworn to and subscribed before me this 8th day of November, 1922.

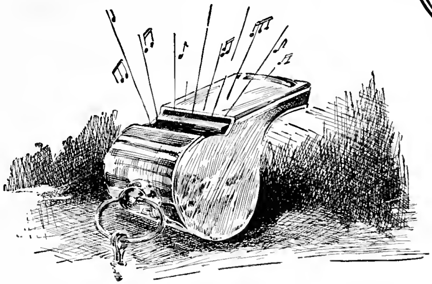
(Seal) (Signed) GEO. S. ALLISON,

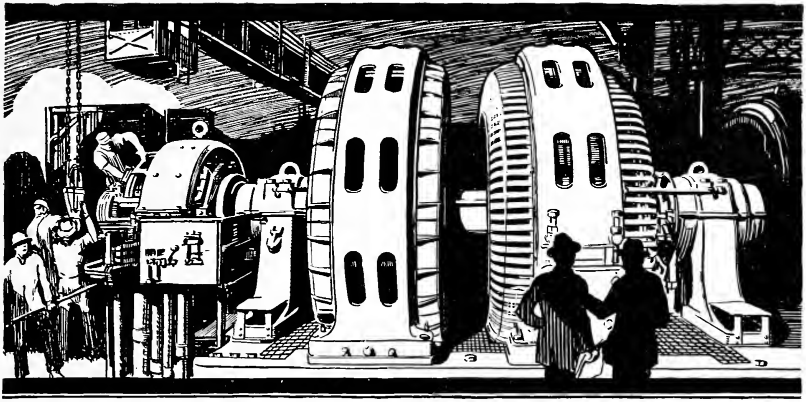
Chicago, November 8th, 1922. *Notary Public.*

Continued from page 8

natural order of things, and not the result of conscientious and often self-sacrificing application by many engineers to problems affecting the community or the race.

Effective advertising by straight-thinking engineers would do a lot to remedy this and to bring about a due recognition of engineering ability and value, and would thus be of substantial service to the individual engineer, as well as to the profession.





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The Armour Engineer

Published by the Students of

Armour Institute of Technology

VOLUME XIV JANUARY, 1923 NUMBER 2

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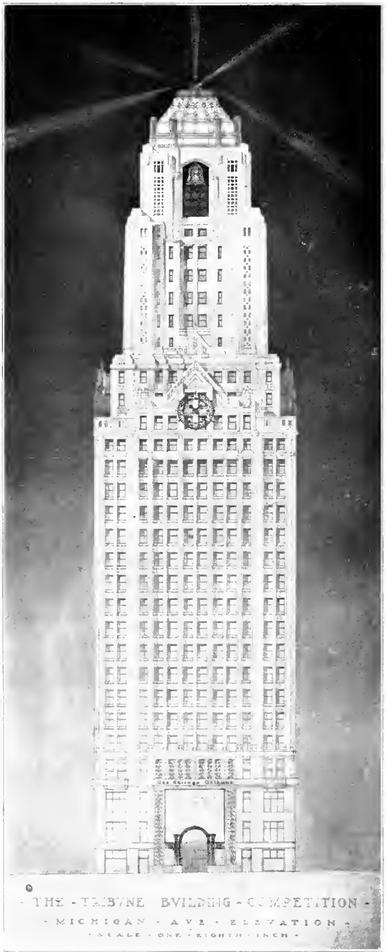


MICHIGAN AVENUE ELEVATION

AWARDED HONORABLE MENTION

TRIBUNE BLDG. COMPETITION

Design by

PROFESSOR EDMUND S. CAMPBELL OF ARMOUR INSTITUTE OF TECHNOLOGY

THE ARMOUR ENGINEER

of the

Armour Institute of Technology

A COMPETITIVE DESIGN FOR A BUILDING FOR THE CHICAGO TRIBUNE

By

PROFESSOR EDMUND S. CAMPBELL

THE following are extracts from the written description which was required as part of this competition. In making the design of this building the main objects have been as detailed below.

To produce a distinctive silhouette unlike that of any other building.

To produce a mass which will so inspire the beholder that he will there see a physical expression of the world's greatest newspaper, in that it is a single dominant form of great force and vigor.

To produce a modern belfry of news sending and receiving apparatus with a search-light platform at the top for flashing elections, scores and the like; also a great bell, the largest in the city, which will toll or ring on the most solemn or important occasions, that is, the death of a great statesman, a great public danger, or rare celebrations; and by smaller bells back of the pierced stone grilles, which will ring for minor occasions. Back of the lower stone grilles will be chimes to ring on the hour, and enliven the holiday, and to accompany the big bell with music fitting the occasion.

To produce the maximum renting area for the typical floor plan. This area is 8,250 square feet and 9,300 square feet above local elevators.

To arrange a very open first floor plan with the easiest access to the elevators, the Tribune counters and the old building.

To distribute the allowable area of 3,600 square feet of the tower by building out forms on the corners and recessing the centers so that the tower will unite with the main mass and not appear to be set upon it but to grow out of it. The recesses will give most interesting play of light and shadow. The area of the plan of the tower is 3,550 square feet.

To provide at the base a bulletin board of ample size so that the latest news can be easily read by all going North or South, with black letters on translucent glass with ample working space between the double glass partitions for the quick setting of the bulletins, either mechanically or by hand.

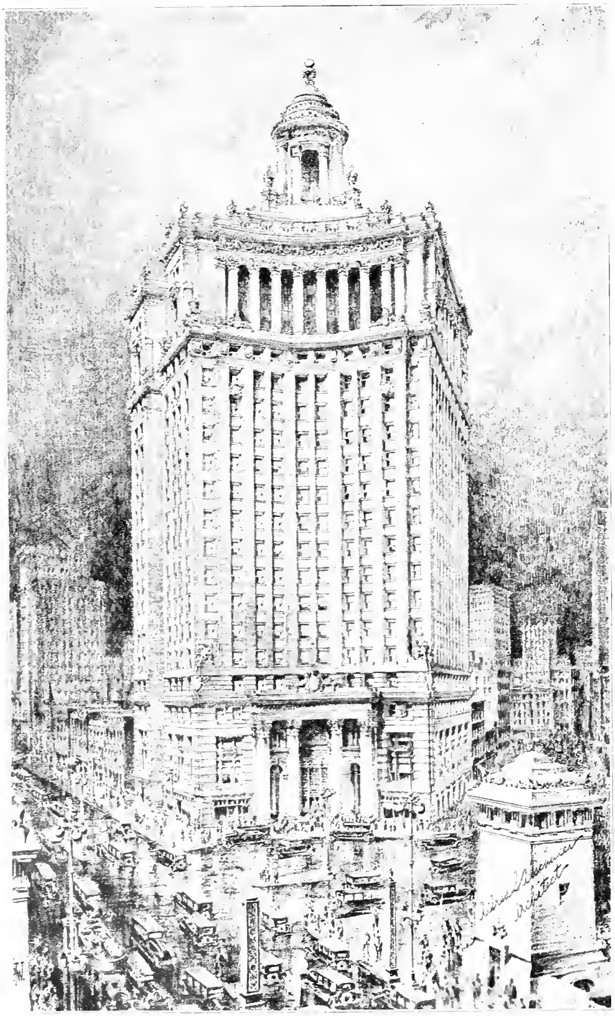
To produce an exceptional lighting effect by means of the pierced stone grilles, the light in the large bell chamber, the great batteries of colored lights in the steel and glass top portions of the tower, and the especially fine opportunity provided for indirect lighting due to the set backs.

To produce an ample lobby lighted through clear glass back of grilles and through the translucent glass of the bulletin board. Seated statues of Lincoln, Medill McCormick and others will be in the four niches of the lobby. The arched entrance can be glazed in winter.

The openings of the tower are all in alignment with the openings of the office building so that the portion of the tower that is not carried directly by piers and girders of the office portion can be easily supported by two continuous girders and other minor girders.

To arrange an ample visitors' observatory platform at the height of almost 400 feet above the sidewalk.

Because of other duties it would have been impossible to have made the six unusual large-sized drawings required in this competition if the competitor had not been aided by a group of undergraduate and graduate students, so in a sense this is really an Architectural Departmental Competition. It is with great pleasure credit is given to I. Jerry Loebl, '21; R. J. Nedved, '21; W. J. McCormack, '22, for their extensive and able assistance; to H. J. Bieg, '21; T. M. Hofmeester, Jr., Class of '21, and W. F. Yerkes, '21, for effective aid, and to S. J. Brenwasser, P. McFarland, E. Fuhrer, A. R. Hauser and W. L. Suter of the Senior Class for their willing co-operation and help. The Seniors were compensated (against their wishes) for their time in order to avoid any obligations of a Faculty member to a student.



LONDON GUARANTEE AND ACCIDENT BUILDING
ALFRED S. ALSCHULER, '99 *Architect*

RECENT WORK BY GRADUATES OF THE ARCHITECTURAL DEPARTMENT OF THE ARMOUR INSTITUTE OF TECHNOLOGY

Alfred S. Alschuler, '99

IN order not to unduly delay the publication of this number by the presentation of the work of some of the graduates of the Architectural Department, it was necessary to eliminate the work of graduates not in the city of Chicago and it has also been found necessary to further reduce the list because of limited space. In some future number the work of other graduates will be presented. It is to be noted this selection is from some of the oldest to the youngest classes.

The work of Alfred S. Alschuler, '99, is represented here by illustrations and his descriptions of two representative types of his work. He is also well known for another type of which the Sinai Temple and its Community Building is a charming example.

The planning of the office building for the London Guarantee and Accident Building on Michigan Avenue and the Plaza raised many problems of an unusual and interesting nature.

The shape of the lot formed by two streets not at right angles and their intersection with the Plaza was quite unusual. In addition thereto, the fact that a small piece of property 24 feet frontage and 55 feet in depth on Michigan Avenue could not be obtained and cut into the property in what at first appeared to be a rather awkward manner, presented an additional problem. Besides this, there was a vacant space 32 feet in width to the west of the building upon which it was planned at some future time to build an addition. Many plans were tried out and carefully studied and the final solution of the problem did not begin to take form until a definite conclusion was reached that the small lot which cut into the property was not of sufficient size to permit the economical erection of any building more than four stories in height. It was then determined to make definite use of this space as a permanent light court and if the property was acquired at a later date, then the lower five floors could be added to the building and the upper portion remain as a light court. It later developed, just as anticipated, that when the owner of the small piece found that he could not block the improvement, he assumed a more reasonable attitude and the piece was acquired and made use of just as planned.

The exterior design of the building also presented some problems. A dignified and monumental building was desired which should properly fit the location, one of the most prominent in the City. On the Michigan Avenue front, the problem was complicated by the fact that the front was cut into two sections of 24 feet and 42 feet respectively. It was only after a great deal of study that a solution was found whereby the upper stories of the two unequal sections were made to balance. This was accomplished by a pylon treatment of these floors, which resulted from setting back the adjoining walls and leaving the center features exactly alike. This also resulted in setting back the walls on the four upper floors of the Plaza front; the main facade on the Plaza then developed in a curved form which added a certain amount of grace and individuality to the building.

Philipsborn Building, A. S. Alschuler, Architect

The Plaza front also presented an unusual problem, as the two sides of the original angle were of unequal length. This difficulty was finally overcome by setting back one side of the building six feet and cutting across the sharp angle at the center, thus making the entire front symmetrical. Besides adding to the appearance of the building, this served a further practical purpose by permitting an increased width of sidewalk on River Street, the improvement of which was not provided for at the time the Plaza was laid out. As originally planned, the sidewalk would have been only six feet in width at the corner. The additional space gained at the corner had a further value at the lower street level where by a rearrangement of the column support below the main Plaza, the space gained will permit a driveway for six teams to pass, instead of four.

The fact that the building occupies the historical site of the original Fort Dearborn has been recognized by the placing of a large bronze tablet over the main entrance door.

The selection of the type or style of Architecture as well as the materials to be used on the exterior, were given considerable study. The Gothic type was first attempted and many studies made, but this was finally abandoned, as it was not considered entirely suited to the surroundings.

As to materials, the conclusion was reached that stone was more dignified and was in every way best suited to a monumental building. This is largely due to the fact that it possesses a certain color and

Shore Crest Apartment Bldg., Robert C. Ostergren, Architect

interesting texture and that it could be obtained in sufficiently large pieces to lend scale to the building. This applies especially to the columns in which it is necessary to preserve absolutely true lines and in which large pieces are desirable.

The exposed location of the main facades made it undesirable to place fire escapes on any of the three main street fronts and it therefore became necessary to place an additional interior fire escape stairway in the building in such a manner as not to interfere with the renting of large general offices or the subdivision into smaller spaces. It was also necessary to avoid interfering with certain special layouts on the five upper floors and to avoid cutting into the main lobby on the first floor. The final result was that this stairway, which normally would pursue a straight and even course, assumed a serpentine form and dodged in and out among heavy beams, columns and girders in a seemingly reckless fashion before landing the traveler near a main exit on the ground floor.

The wind bracing on the exceedingly narrow wings, the engineering calculations due to the irregular shape of the property making hardly two columns alike, the making the best use of every available foot of space for renting purposes, all presented problems requiring careful and unusual study.

In the course of the development of the plans for this building there have been many other problems of interesting but not of such an unusual nature and therefore they will not be discussed at this time.

The Philipsborn Building presented problems of an entirely different type. This is a building housing a mail order business exclusively for women's apparel. The first unit was to occupy about a third of a square block located on Congress Street from Paulina to Marshfield Avenue in Chicago. This was to be planned for the most economical operation of this first unit and at the same time, laid out in such a manner as to provide for future expansion.

It is unnecessary to say that whereas but a few years ago such a building would have been designed first and the business then fitted into it, today the entire business operation is first thoroughly studied before even sketches of the building are made.

Robert C. Ostergren, '08

Trips were taken to all the principal points in the United States and Canada where businesses of a similar nature were in operation and a large amount of information gathered. This was of value not alone as information of a positive nature but served as well clearly to point out what should not be done.

After this mass of information was gathered together, it was carefully sifted, and only a very few facts of value remained. These were again thoroughly studied and some of the ideas of the various Institutions combined in an entirely new manner and crystallized. The most valuable single item gathered was that of a simple conveyor which carried empty boxes to the packers in a novel manner. This was picked up by chance in the basement of a comparatively small business and was considered of far greater value than the expensive devices of the larger institutions. This idea combined with the entire assembly and shipping system which was developed proved to be in a way the key to the solution of the entire problem.

It might be mentioned that in a mail order business of this character where hundreds of thousands of orders are handled weekly, the chief factor is to provide for the minimum amount of handling of all articles of merchandise. All goods which come into the house must be distributed with the smallest possible amount of travel, and after distribution, the orders must be picked separately and the goods reassembled likewise, with the shortest possible amount of travel and the least handling.

The average order from a customer consists of about four separate items and the entire arrangement of stock on the merchandise floors must be planned for rapid handling of orders. Conveyor systems and chute must be so arranged that all the items on any order can be scheduled to meet and be gathered together in a predetermined bin on the assembly floor within a twenty minute period.

It is also necessary to provide a system of belts, tables, balconies, conveyors and chutes whereby the articles can be inspected, packed, weighed, stamped and placed in mail bags without delay. This system must work so that all goods flow like a stream through the house without any interruption, as the blocking or stoppage at any point might become a serious matter.

It was only after all these problems were satisfactorily worked out, that the elevators were finally located at the center line of building but removed a distance of 10 feet from the wall line. This was rather unusual but was done to permit the toilets to be located at the windows in back of the elevators

Charles D. Faulkner, '13

and thus absorb the least amount of daylight.

The entire top floor was provided with sawtooth skylights and used for general offices in order to provide a daylight floor for executive work. The seventh floor is devoted entirely to restaurant, recreation and welfare departments which are quite well developed. Another advantage gained is in the fact that the travel of the goods is that much shorter than if the two upper floors had been used for merchandise. The third, fourth, fifth and sixth floors are all merchandise floors in which the stock is divided as "reserve" and "forward" or "active" stock where orders are filled and at stated intervals sent down a spiral chute to be assembled on the second floor.

The first floor is arranged for a Receiving and Shipping Room, Return Goods, Reserve Stock and a large box factory where cardboard boxes are made, in which a larger portion of the goods are shipped.

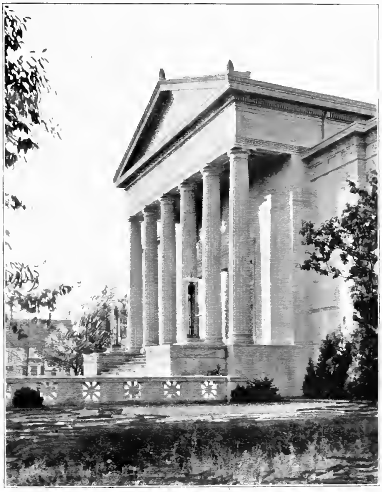
The hundreds of details which had to be considered would take a long time to describe here. The building, however, was fitted to the business, a second unit was added and preliminary studies are now being made for a third unit, which will then cover the entire square block.

The Architect of commercial work of today who is called upon to act as Efficiency Engineer in the development of his plans rarely finds more interesting and varied problems than those presented in the construction of a building for mail order concerns.

Robert C. Ostergren, '08, is well known to all Armour men in addition to his work as an architect by his five years of very loyal service as a faculty member in the Architectural Department. Since 1912 he has been in practice with his own office except from 1912-1918 when he was in partnership as Hall & Ostergren, and during the recent war when he was Captain in the Quartermaster Corp and was engaged in Hospital Construction Work.

The example of Mr. Ostergren's work illustrated is The Shore Crest Apartment building located at the northeast corner of Wrightwood and Pine Grove Avenues, Chicago. This was built in 1917 and was one of the first "Kitchenette" Apartment Hotels built in Chicago. It is a seven story reinforced concrete building containing 120 apartments, ranging from one to four rooms. The main floor has all the features of a regular hotel.

One of the fine qualities of this hotel is the beauty and excellent scale of the detail which is evidenced in all of his work, from the smallest home to his largest commissions. His practice has been quite varied from theatre buildings to a cemetery layout. Other important works are Alemite Die Casting Manufacturing Company's Plant, Wanner Apartment Building, 5442 Hyde Park Boulevard, Bertha Apartment, Anderson Cowie Apartments, Cemetery, Office buildings and entrances.



First Church of Christ, Scientist (Lakewood), Cleveland, O.
Charles D. Faulkner, Architect

From the many fine pieces of architecture already designed by Charles D. Faukner, '13, a view of First Church of Christ, Scientist, Lakewood, Ohio, has been chosen for illustration and the next few paragraphs written by Mr. Faukner, show his enthusiasm for his profession as well as the great variety of work, that may come in an architect's practice even in a few years. Besides his practice Mr. Faukner has up to this year carried on teaching work in the Art Institute, Art School Interior Decorating Class and Evening School classes in Architectural Design.

After graduating from school, the architect usually finds his nose in close contact with somebody elses drafting board. Of course, he may have been lucky enough to choose a father that would realize the great benefit which would accrue to his business by the acquisition of young blood. However, most of us are not so fortunate, and our professional careers must be set in motion by self starters or not at all.

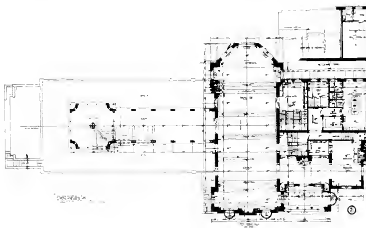
It is very interesting to observe the actions of those odd people known as our clients when we start out to demonstrate our superhuman ability. I remember the first residence that I was called upon to design after hanging up my shingle. The owner of this residence seemed quite surprised that I did not think to put in any front steps. I thought nothing of the incident myself, quite evidently. If I had I would have had a much less embarrassing position to "explain."

But in spite of all that we can do, and in spite of our own efforts to increase our business, our practices do seem to increase in both quality and volume. Of

V. S. Watson, '00

course, we are always up against the necessity of convincing our prospects that we each are the original and only.

One recent project which is very interesting from a design standpoint is that of the Nippersink Lodge at Genoa Junction, Wisconsin. There are some twenty-six buildings in all, situated in a beautiful rolling and wooded lake portion and all designed in the English Tudor style of architecture. The roadways are winding, and the picturesque natural surroundings are complimented by the architectural style used, and the fact that no two of the buildings are alike in purpose, size or design. The main building is a large club house containing an old English Great Hall, 25 feet wide, 70 feet long and 27 feet high, used as a lounge, with writing rooms, men's smoking room, ladies' rest room and locker room, men's locker room, refectory, private game rooms, and, of course, a large porch. There is also a separate dining hall building, containing the main dining room with its private porches, and the kitchen and service portions. The sleeping portions are found in cottages which range from four rooms and porch to one room and porch. In addition, there is a garage, power house, golf shelter, children's playhouse, etc.



Main Floor Plan

Hinsdale Golf Club, Hinsdale, Illinois
Tallmadge & Watson, '00, Architects

First Church of Christ, Scientist, Lakewood (Cleveland), Ohio, was a project of very different type. This building of necessity had to portray great dignity and substantiality. It is built of stone, entirely around all sides, contains an auditorium which seats 1,050 people, together with the usual appointments found in large up-to-date city churches.

The building of churches naturally takes one to widely divergent parts of the country. My own experience has ranged from Colorado west to Washington, D. C., east, in which city I am now doing the most important of my public building work in connection with Second Church of Christ, Scientist, of that city.

In Chicago the Oakhaven Old People's Home is being built after my design, and will be completed some time this coming summer. The housing of old people is an interesting study itself, and their interesting eccentricities, which must be taken into consideration, would fill many humorous pages.

In presenting architectural work by Tallmadge & Watson, '00, which follows, attention is called to the cover which represents the work of three persons connected with the Architectural Department of Armour Institute; that is Mr. Thomas E. Tallmadge, formerly faculty member, teaching design and now for many years special lecturer in History of Architecture; Mr. Emil Zettler, special instructor in Architectural Modeling; and Mr. V. S. Watson of the Class of 1900. The Doughboy is a memorial figure sculptured by Mr. Zettler, placed at the corner of the cloister of St. Luke's Episcopal Church, Evanston, Illinois, which is the joint architectural work of Tallmadge & Watson.

It is with regret that the most interesting view of the Hinsdale Golf Club temporarily lacks the planting necessary at the base of the building for a pleasing photograph; however, the originality that has always characterized the work of this firm, both in plan and elevation, is in evidence in the photograph chosen. This is not a stereotyped half-timber English archaeology solution, but an interesting use of the materials in a modern way of the English half-timbered type. The problem is best described by Mr. Watson in the next paragraphs. This firm is undoubtedly the best known of church architects in the middle west.

The large number of fires which have destroyed outlying Golf Clubs in the last few years have presented a new problem to Architects.

The problem is to construct a building essentially fireproof without being prohibitive in cost and besides satisfying all the requirements of practicability and retaining those elements of the beautiful and the picturesque, usually associated with buildings of this character.

One of the first, perhaps the very first of these solutions of a fireproof golf club in this locality, is to be found in the Hinsdale Golf Club, Hinsdale, Illinois.

The site of the Club suggested the solution of a rather difficult problem in that the rolling contour of the land allowed of grade approaches for the various departments of the building.

The basement is built on a line with the lower approach and contains the men's locker room, grille and kitchen, together with the necessary service portions such as toilets, laundry, boiler room, and servants' dining rooms.

The locker room, 46 feet by 86 feet, being one story high, allows of a terrace treatment in its roof construction. This opens off of the main lounge and dining room, 30 feet by 86 feet, located on the main floor and due to its height above ground, affords a beautiful view over the entire course. The balance of this floor is devoted to a ladies' parlor and the ladies' locker and shower rooms together with the main entrance and office.

The second floor is utilized entirely for bed rooms and is so divided that it can be used for both bachelor and family suites.

The entire construction is strictly fireproof including the roof. Due to the heavier loads in the main floor, a reinforced concrete construction was used which included both girders and slabs.

The second floor is utilized entirely for bedrooms built of hollow tile and concrete supported on steel beams. This construction was found to be very much cheaper and easier to handle especially during the winter months encountered at the time this work was in progress of construction.

The roof was built of 3 inch plaster blocks supported by Tee irons and steel trusses. These blocks afforded perfect nailing for a heavy textured slate roof and has proven very satisfactory.

This crowns an exterior of simple lines which with its half timber treatment lends itself to the environment usually found in buildings of this character.

W. Campbell Wright, '18

Too, most architects who would look upon the Associated Silver Company's office building as just another factory type whose fee would help pay the office rent, has been to Monaco, '18, & Wright, '18, an opportunity to show their ability as really true artists. To make a pleasing piece of architecture with a few simple elements with many practical restrictions by a proper distribution of voids and solids and a logical use of material has been their accomplishment.

The more intimate side of the architect's practice is frankly stated by Mr. Wright in the accompanying paragraphs. With Wright is associated Everett F. Quinn, Class of 1918 and R. T. Christensen, Class of 1919, two very popular former architectural students.

There is hardly anything that appeals less to the average man than writing about himself or his work for the edification of a probably disinterested public. However, be that as it may, we will assume that

The Associated Silver Company Office Building. Monaco & Wright, Architects

Columbus Park Refectory Building
Chatten & Hammond, '04, Architects

among the countless readers of "The Armour Engineer" there might exist one or two who would be interested in hearing the how and the why and possibly the wherefore of the firm known as Monaco and Wright, Architects. Starting with the how, then:

In December, 1919, four members of the Class of '18 met in one of the Art Institute classrooms to have a look at the old Ecole and to talk over old times. All of us had been in the Service, in various degrees of activity, and had not seen each other for some time. In the course of getting reacquainted, someone suggested the possibility of a partnership, and the idea seemed to take root immediately. Therefore, on January 3, 1920, we again convened, in Jarvis Hunt's library, and went through some very informal preliminaries, which consisted mainly in flipping a coin to decide what the name of the firm should be. The following week we rented an office on the 10th floor of the Federal Life Building at 168 North Michigan Avenue, and went on the warpath for work. We probably will never forget that office, where our windows commanded a view of Lake Michigan which very often interfered with our work (when we had any). On clear days we could easily see the dunes to the southeast, and sometimes even the silhouette of buildings on the Michigan side.

Shortly after this, we received quite a severe upset. Due to the death of Monaco's father, his family suddenly decided to move to Los Angeles, and carried out their decision with such dispatch that before we realized what was happening we were minus a partner. To say we missed him would be putting it mildly. We hoped for a time that he could be lured back, but as time goes on we become less hopeful. He has opened an office in the Bankitaly Building, under the firm name of Monaco and Bordeaux, and, judging from our correspondence with him, seems to be succeeding very well.

Columbus Park Refectory Building
Chatten & Hammond, '04, Architects

To resume the "history," we stayed at the above address a little over a year. Then, feeling the need of larger quarters, we followed the general movement north to our present location at 721 North Michigan Avenue. Here we have ample space and the best of light, as well as freedom from the noise and dirt of the loop.

As for our work, it has been widely diversified in nature, embracing residences, apartment buildings, churches, office buildings, warehouses, garages, and remodelling work of almost every type. The photograph shown herewith illustrates the Associated Silver Company's office building at 4456 Ravenswood Park (to which we recently added another story). The last mentioned is flat-slab-type reinforced-concrete, studied more for economy and efficiency than for architectural design, as the Associated Silver Building was one in which the main requisite was a maximum of light and a minimum of structural members.

On the whole, we feel that we have been very fortunate in that we were able to weather the storm of the last three years, which were certainly not what they might have been for "struggling young architects." However, we are still actively engaged in pursuing the profession, and live in the hope that some day we will catch up with it.

The two illustrations of the Columbus Park Refectory Building and Boat Landing are from the work of Chatten & Hammond, '04. Mr. Hammond is at present vice president of the Chicago Association of Commerce, a former faculty member of the Architectural Department and a Captain in the Aviation Corps in the recent war.

The building has recently been completed and is an imposing structure built of brick with Bowling Green stone trimmings and red tile roof. It is located at the west end of the Columbus Park lagoon, and is 270 feet long measured in an east and west direction, with a pavilion extending south 89 feet from the building. The building is fireproof throughout. At the west end, extending out into the water, there is a concrete boat landing 100 feet long and 20 feet wide, built on concrete piers.

The building is equipped with assembly rooms, kitchen, and dining room, with the necessary lobbies, check rooms, toilets, etc.

There are concrete terraces on the north and south sides, the north terrace overlooking Jackson Blvd. and the south terrace, the lagoon.

The lower floor of the building is arranged for boating in the summer, and to accommodate skaters during the winter time, with provisions for checking 1,000 pairs of skates.

These short notes and illustrations of seven buildings are only an indication of the great fund and range of knowledge that an architect must have to readily solve the problems presented to him. Or if

he does not he must be sufficiently organized to have others at his disposal to supply those things to which he cannot devote his time, or even cannot do. It is generally recognized that the architect must be trained on broad, general lines so that to each problem he may apply his fundamental knowledge and quickly gather or have gathered for him the detail knowledge peculiar to each problem.

NOTES OF DEPARTMENT OF ARCHITECTURE

In the presentation of two illustrations of Students' work the Department has chosen two prize problems. Little publicity has ever been given to the second place, L. J. Cardwell, '20, won in the American Academy in Rome Competition in the summer following his graduation. The final problem was A Memorial Building to a Great Statesman. Five competitors were selected from an open national preliminary ten-day competition. Mr. Cardwell expects to compete again this year and we wish him all success.

In the last school year a competition was held in the Junior and Sophomore Classes for a prize of $100.00 given by Mrs. Samuel W. Allerton, for the development of ideas of a distinctive small town type of library. The usual type built is something far too monumental for their location. This prize was won by Victor H. Proetz of the Junior Class. J. R. Koberling of the Sophomore Class was a close competitor and with Alice O. Smith of the Sophomore Class received first mention from a jury composed of Chicago Architects. A number of other distinctive designs were presented. One of the main requirements was that the rooms and surroundings should present a homelike rather than an institutional atmosphere. An actual site was given for a town in Central Illinois and without doubt this library will be built according to the prize solution with certain modifications suggested by the jury and the donor.

The Department has recently received the three medals awarded by the Beaux-Arts Institute of Design, to H. K. Bieg, '22, during the past year and the two medals awarded to I. Jerry Loebl, '21, a post graduate student of the past school year.

It is confidentially expected that the present Senior Class will obtain several medals in their second semester. W. L. Suter has easily led the Senior Class the first semester with two first mentions.

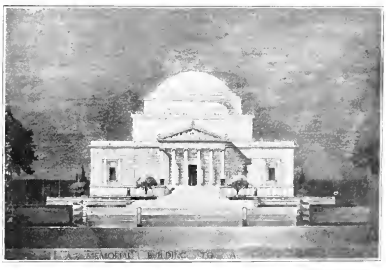
A new bulletin of the Department will be issued in the second semester and increased space will be devoted to water color and free hand. The modeling work under Mr. E. Zettler will be illustrated for the first time.

The Department was admitted as a member of the Association of Intercollegiate Architectural Schools at their June Convention in Chicago. This membership entitles graduates of the Department elected to membership in the American Institute of Architects to admission without taking any examinations. The Department has had requests for exhibitions of students' work in design and water colors from some of the schools who visited the Department during the meeting of the Associate Intercollegiate Architectural Schools. The Association has an annual convention and semi-annual meetings of the executive committee for the purpose of the advancement of architectural education.

A Small Town Library by Victor Proetz

For the first time in the history of the Department, a uniformed guard of The Art Institute has been placed in architectural quarters. The south staircase is closed to everyone and the maintaining of discipline necessary to our quarters over the Art Institute galleries has been ably accomplished by Mr. Wagner, who is at the same time the friend of all the students. The Department runs much smoother in many minor details in which he is able to give valuable assistance.

Mr. H. K. Bieg, '22, won second prize in a recent Van Dort Sketch Competition of the Chicago Architectural Club.



A Memorial Building by L. J. Cardwell, '20
Placed Second, American Academy in Rome Competition

"PITTSBURGH PLUS"

By

E. J. Buffington,
President The Illinois Steel Company

EDITOR'S NOTE: There are always two sides to every question, each of which it is necessary thoroughly to understand before an accurate, unbiased opinion may be formed. The article favoring the abolition of the Pittsburgh basing plan having been published, the Editors are therefore pleased to be able to present to our readers the following letter from Mr. E. J. Buffington, President of the Illinois Steel Co., which discusses the opposite side of the question:

Mr. John V. Lizars, Editor-in-Chief,
The Armour Engineer,
Chicago, Illinois.

Dear Sir:—

Upon my return from a recent absence your letter of November 1st inst. is received, stating that an article for publication in your paper on the subject of the "Pittsburgh Basing Plan" has been offered by the Western Association of Rolled Steel Consumers, and asking that we submit an article upon that subject suitable for the purpose of informing your readers.

A clear understanding of the subject requires that it first be defined. It is necessary that we should have clearly in mind not only what it is, but also what it is not.

What is commonly called "Pittsburgh Basing" or sometimes "Pittsburgh Plus" means this: Sometimes a producer of steel at a point distant from Pittsburgh sells his steel at various points for a price which is the sum of the price of such steel at Pittsburgh plus the freight to those points. Stated more concretely, for many years past the prices of some steel products in Chicago have commonly, although not always, been the sum of the prices of such products at Pittsburgh plus the freight from Pittsburgh to Chicago. Such "Pittsburgh Plus" prices are not the result, as is so many times assumed or implied, of the adoption of a "Plan" by any manufacturer or group of manufacturers. No one has adopted an artificial or arbitrary method of fixing prices. On the contrary, the "Pittsburgh Plus" prices are the natural result of the free play of economic forces. The "Pittsburgh Plus" prices at all places are the natural market prices at those places.

"Pittsburgh Plus" or "Pittsburgh Basing" has come in the common mind to have reference to the price of steel. Exactly similar price conditions, however, apply to grain, sugar, and a great many other commodities. In discussing "Pittsburgh Plus" or "Pittsburgh Basing" we are discussing merely one specific illustration of the effect of many producers on the one side attempting to sell their products and many purchasers on the other side attempting to buy those products, all under varying market conditions.

Since the beginning of the manufacture of steel in the United States, the Pittsburgh, Pennsylvania, district has been, and continues at the present time to be, the largest steel producing district in the country. If one desired to purchase steel for use in Chicago when no steel was produced in Chicago, the cost to such purchaser was then the price of steel in Pittsburgh plus the freight to Chicago. In other words, the price was a Pittsburgh plus price. When Chicago began to produce steel, but in quantities insufficient to supply the demand in Chicago, then the purchasers in Chicago were still compelled to get part of their steel in Pittsburgh. When they bought steel in Pittsburgh, the cost to them at Chicago was the Pittsburgh price plus the freight to Chicago. In other words, the price was Pittsburgh plus. Under these conditions, if a purchaser of steel in Chicago offered to buy from a manufacturer in Chicago, when, as stated, the manufacturers in Chicago were able to produce and furnish only a part of the demand in Chicago, what would the price naturally be? Take into consideration practical trade conditions, what would the price be? Why, if part of the purchasers of steel were obliged to go to Pittsburgh for their steel and pay the Pittsburgh price and then pay the freight from Pittsburgh to Chicago, that established the market price in Chicago. The Chicago producer could readily get a price which was the same as the cost to the purchaser who obtained his steel in Pittsburgh, that is to say, the Pittsburgh price plus the freight from Pittsburgh to Chicago.

As stated above, the Pittsburgh district is the largest steel producing district in the country. No other district in the United States produces a sufficient amount of steel to supply the adjacent country under normal trade conditions. Therefore, under normal trade conditions, all districts in the United States are generally dependent upon the Pittsburgh district for some part of the steel which they require. Naturally then, not as the result of any artificial plan, but as the result of the free play of the laws of supply and demand, the prices in these districts come to be the prices which equal the sum of the Pittsburgh prices plus the freight

Of course, if the time ever comes when the Chicago district produces a surplus of steel so that the entire demands of this district are supplied by steel produced in Chicago and the surplus presses out towards Pittsburgh, or in other directions, the prices of steel at Chicago cannot be Pittsburgh plus prices. Under those circumstances, Chicago will establish its own prices.

An illustration of this may be found in the actual experience of the trade recently. A year or so ago the demand for steel fell off to such an extent that the producing capacity of the Chicago district exceeded the demands of that district. Quickly the prices in Chicago fell below the prices in Pittsburgh plus the freight.

In substance, the prices of steel in the regard we are considering, are no different than the prices of grain. Chicago is the greatest grain market of this country. There is always a market price for grain in Chicago. Vast quantities of grain come into Chicago from the fields where produced, and are then distributed from

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FIRE PROTECTION ENGINEERING

By

C. M. Cartwright

Managing Editor, The National Underwriter

FIRE insurance companies are particularly interested in watching the careers of the young men who during the last few years have entered their business, having been prepared especially by vocational education for it. Armour Institute of Technology has the only Fire Protection Engineering course in the country. The young men who pursue that course and have the field work in connection with it, possess an intellectual and practical equipment that is most valuable when they enter the fire insurance field.

It may be interesting to know just what the fire insurance companies had in mind when they established scholarships at Armour Tech in order to encourage capable and aspiring students to pursue this line of study. Up to the time Armour Tech arranged for the Fire Protection Engineering course, there was no particular course in any college that led up to technical work in fire insurance. Students who took mechanical and electrical engineering, it is true, had many advantages over those who followed other courses. The work in freshman and sophomore years in technical schools forms the ballast, so to speak, on which the track is laid during the last two years of college life.

The insurance companies felt that during junior and senior years there should be some definite line of work that leads directly to fire insurance activities. The insurance company officials in studying the records of men who had entered their business found that those who possessed a technical education were able to take a far more comprehensive view of fire insurance work, and could get farther and arrive at their destination much more quickly than those who did not have this advantage. The big majority of men who were not technically trained were able to go to a certain point, and there they stopped. As fire insurance has become very complicated in its structure there are greater responsibilities; and as the public realizes its importance as the basis of credit, fire insurance company officials appreciate that a body of well trained men should be brought into the business, who by nature and training would be able to carry on the work even more successfully and efficiently than it has been done in the past.

The young men who are being graduated from Armour Institute and who have pursued the Fire Protection Engineering course will be the men who will take high rank in the fire insurance business in the future. Unless this technical training is secured early in the career of a fire insurance man he never gets it. There is a big advantage to anyone entering this big business to know something of the technical side. The president of an insurance company would make a far more satisfactory president if he were able to apply the rating schedule intelligently. He would make a better president if he were acquainted with fire protection engineering. The technical training gives a young man an insight into the mechanics of the business, so to speak, which furnish him the kit of tools that he will use every day.

I have been noting with interest the demands that are being made by insurance companies on those whom they are selecting for higher positions. In many instances the question is asked whether they are acquainted with the rating schedule and can apply it intelligently. Their technical training is carefully analyzed. The big demand in fire insurance today is for men who appreciate the demands of the big premium payers and are able to meet them. When a man is competent to make an intelligent study of a fire insurance risk and advise the policy holder what he can do to improve his property in order to reduce the fire hazard and thereby secure a lower insurance rate his services are in demand. Local insurance agencies throughout the country are putting in what is termed "service engineers." These men devote their time to studying fire insurance risks so that proper advice can be given and thus a big service rendered.

The fire protection engineering course to me is one of the most interesting with which I am acquainted, because it carries out an educational plan that it seems to me is highly desirable. In the first place it is necessary to have a broad and enduring educational foundation. This is secured through the study of those subjects that develop one's mind and show a young engineer the rich fields that are his to traverse. While this study or research work is going on it is certainly a tremendous advantage to a young man to see how at least some of the theories he is encountering can be put into actual application. In the fire protection engineering course, especially in connection with the scholarship students, ample opportunity is given for laboratory and field work. In many cases these young men are attached to the insurance rating bureaus during their summer vacations and thus they come in contact with the actualities of the business. It is an exceedingly broad and useful training. The time spent in the Underwriters' Laboratories at Chicago also enables these students to participate actively in the real work that is being done by the insurance companies along fire prevention lines. There is no other institution like the Underwriters' Laboratories in the world. It is the testing place for all fire protection devices and materials. The insurance companies rely absolutely on its findings.

When a young man has graduated from Armour Tech and has faithfully applied himself in the fire protection engineering course, his services are immediately in demand. I know of insurance companies that will take a fire protection engineering graduate of Armour "sight unseen," because they realize that if this graduate works, has even moderate ability, and is willing to obey orders, he will develop into someone worth while. The fire protection engineering graduate has a position created for himself immediately. There is a growing demand for these technically trained men. The fire insurance business needs them badly. The insurance companies are awaking to the fact that the public must be served more efficiently and intelligently than it has been in the past.

The fire insurance business is growing steadily and rapidly. The problems before it are becoming more intricate. Its relationship with the public is intimate

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THE ARMOUR ENGINEER

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EDITORIALS

"THE ARMOUR ALUMNUS"

THE whole hearted enthusiasm and effort which are being put forward by the officers of the Alumni Association to make that organization bigger, stronger and better, evokes our sincerest admiration and respect. The new *Armour Alumnus* is especially worthy of comment. It is bright, interesting, and snappy, and although still in its infancy and concerned principally with the business of organization, it is increasing in size and circulation by leaps and bounds. It becomes increasingly apparent each issue that *The Armour Alumnus* is bound to take an immensely important part in Alumni affairs.

PITTSBURGH BASING

The article on Pittsburgh Basing, which was published in the last issue of The Armour Engineer, has been the cause of much favorable comment, particularly on the part of the alumni. The Engineer has been repeatedly congratulated for its selection of such a timely and important topic. On account of this display of interest, a word of explanation is thought advisable.

It has not been the aim of The Armour Engineer to in any way encroach upon the field of the official journals of the iron and steel industry, in which appear upon this subject an extremely large number of detailed discussions, records of proceedings of investigating committees, and so forth. Naturally, each such article presents the subject in the light most favorable to the interests toward which the journal in which the article is published has a tendency to lean.

It has therefore been the purpose of The Armour Engineer to obtain from the local people most concerned a thorough, yet brief and concise discussion of the significant points involved, in order that without wading through volumes of material, our readers might become thoroughly informed upon both sides of this important question.

Many thanks are due both Mr. Buffington of the Illinois Steel Co. and Mr. Emerich of the Western Association for their kindness and co-operation.

"TACKLING TECH"

A most excellent book, and one which every student should read, has just been added to the library. It is "Tackling Tech," by L. W. Conant, consisting of valuable suggestions and advice for undergraduates of technical schools and colleges, on a variety of subjects pertaining to "Tech" life.

"Tackling Tech" is comprehensive, systematic, and interesting, and, moreover, thoroughly practical from cover to cover—a rather exceptional characteristic for a work relating to problems of personal conduct. Armour Tech students will be particularly interested in recognizing in this book a valuable counterpart to the suggestions and ideas relating to student life contained in Doctor Monin's incomparable lectures and talks.

PARTICIPATION

It is frequently a perplexing problem to the college man as to just what proportion of his time and energy he is justified in devoting to influences other than those of the class room. Most men in college are willing to concede the fact that their job in life at that particular time is to make good in school. But on the other hand any healthy young fellow has a mental picture of the "book worm" with his sallow face and thick glasses, and such a picture is a hard push along the easy and inviting path of pleasure.

Granting, then, that good hard application to studies is of prime importance, it would be regrettable were all college men to look no further than their text-books. After all, being just "livable"; being able to get along with one's fellow-man is, in the long run, a good start in the race of life.

And perhaps at no other period in a man's life does he have such an opportunity to develop this trait as while he is in college. One of the most broadening influences in school life is the participation in school affairs: glee clubs and orchestras for those who have a taste for music; the gym and athletic field for those adapted to athletics; business jobs in connection with school organizations for those who have ability in that direction; and a host of other activities present themselves in inviting array.

It has been often stated that "you can lead a horse to water, but you can't make him drink." It doesn't matter whether we have been led here or not; let's enter into the activities of school life without being made to, that we may reap the reward that is sure to follow the fellow who has learned to co-operate and to be just "livable."

"When an archer misses the center of the target, he looks within himself for the cause."—*Confucius.*

ASSOCIATE PROFESSOR JAMES C. PEEBLES, *Editor*

THE various branches of engineering which are taught at the Institute are primarily applied science. Occasionally a graduate enters the field of pure science, but the great majority of the alumni are engaged in the application of natural forces, under the control of scientific principles, to the uses of mankind. Architecture on the other hand is fundamentally a fine art, and one about which we engineers with but few exceptions know too little. It should be of interest, therefore, to the great majority of Armour Alumni to hear something about the doings of some of our graduates in architecture after they go out from the Institute.

The young engineer when he finishes his college course can find in our own country and very likely in our own city almost any branch or phase of engineering in which he may be interested. Furthermore he will find it in a high state of development, for American engineers are the equals of any in the world in this relatively young profession. But architecture is one of the oldest of the fine arts which older civilizations have practiced for centuries. In Europe it has been brought to a state of development unapproached as yet in our own country. Hence the young graduate in architecture finds it of great value to continue his studies abroad where he may gain inspiration from the world's masterpieces of architecture.

Norman J. Schlossman, '21, has been traveling in Europe for some time. In a recent letter to Professor Campbell of the Architectural Dept., he writes in part as follows:

"These are the last few weeks of my stay in France, and it will be with genuine regret that I leave even to go to the alluring spots of Italy, for I feel that my stay here has been most instructive and time well spent. Chartres alone, so I felt when I first beheld the interior, was enough to justify my entire trip. The towers, the portals, the porches were all magnificent, but the stained glass represented something to me which I never before knew existed. When I ascended the towers the sacristan honored me (at least I thought so) by allowing me to help him ring the big bell, one of those foot-pedal affairs. Perhaps that accounts in part for my feeling such an interest in the place.

"In traveling through the chateaux country I followed to the letter the itinerary which you gave me, and I am sure that without it I would have been at a loss where to go. Of course Baedeker has also been a great help, but I believe that "Campbell's Guide for Traveling Architects" is far superior. In visiting the chateaux in the vicinity of Blois, Beauregard, Cheverny, and Chambord, we rented bicycles and used them to good advantage, for the railroad service to those places was outrageous.

"Chenanceaux is another monument towards which I feel more than a passing interest, not only because of the problem that Nedved* did back in school, but also because I was introduced to the owner, Gaston Menier of chocolate fame. He was very kind to us indeed, and gave me permission to sketch inside, a favor which I was grateful to accept.

"Mont St. Mihiel, needless to say, thrilled me immensely and I stretched my allotted time there into three days. The abbey is undergoing a very thorough restoration and I believe it is being done in a very intelligent manner with the idea of preserving so far as possible the old spirit. I had read somewhere that the Mont had been spoiled on the shore side by the modern houses and hotels which encircled it, but fortunately it did not impress me so. I found the mass and silhouette of the whole from almost any angle positively charming.

"Upon my return to Paris—I had been there for a month before—I met George†, who as you probably know is in the preparatory atelier of Labro and Lemasquieri, and who says he is going to write and tell you all about it. I managed to see both the Autumn Salon and the first exhibition of Class A work at the Ecole, but was rather disappointed with both.

"The towns in this region have been positively blown to pieces, especially Soissons and Rheims. Some of the freakish modern-looking stuff that is arising among the ruins is enough to give one's artistic sense a shock. The work of restoring the cathedral seems to be progressing along definite lines, but over here things are done so slowly that it will be a long time before this place begins to look like a city again. One would never think it four years since the end of the war.

"We shall stop about one week in Switzerland and then on to the last lap of our journey. It appears at present that it will be only with the greatest difficulty that we can sail home from Naples and enjoy stop-over privileges at Gibraltar but the plan is such an admirable one that I shall not abandon it until the last, and shall plan everything accordingly.

"I have attempted to make a water color of Notre Dame from the same angle as yours, and after looking over the results I solemnly advise you to raise your price."

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*Rudolph J. Nedved, A. I. T. '21.
†Geo. D. Connor, A. I. T. class of 1921.

George D. Connor of the class of 1921 has been abroad for some time for study and travel. He writes from Paris, where he has just arrived after an eight weeks' trip through England. He went first to London,

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COLLEGE NOTES

ONE of the most interesting and instructive talks which it has been the privilege of the Senior Class in Business Law to hear this year, was delivered by Mr. Lester Armour a few days prior to the holiday vacation. Mr. Armour told of the rise and growth of the packing industry, now a truly scientific enterprise, every phase of which requires the direction and oversight of technically trained men, from a slaughter house.

Mr. Armour's obviously enthusiastic interest in, and thorough understanding of the packing industry predominated in his discussion and furnished an excellent example of the attitude toward his life work that an engineer must attain in order to reach the pinnacle of success.

The address of Mr. Earl H. Reynolds, President of the Peoples Trust and Savings Bank of Chicago, before the Business Law Class on the subject of banking, preceded Mr. Armour's talk by about a week. Mr. Reynolds detailed briefly and interestingly the various phases of the banking system in one all-too-short hour. Such discussions as that of Mr. Reynolds not only add variety and interest to the "daily grind," but form an excellent basis for future reading and study upon the subject.

President H. M. Raymond attended the meeting of the College Presidents of the State of Illinois, held at the University of Illinois on December 9th. Thirty of the executives of the major institutions throughout the State were present. The subject under discussion was "The Criterions of a Standard College."

Practical Mechanics and Strength of Materials," by Professor C. W. Leigh, has just come from the press of the McGraw-Hill Co. It is the culmination of years of experience and observation, to say nothing of the four or five years required for its actual preparation. This excellent work is designed principally to meet the needs of the practical man, and is written in such a manner as to require a minimum of mathematical training for its understanding.

("When does summation X, Y, Z, and moments equal zero?")

Professor T. A. Doubt attended the meeting of the American Association for the Advancement of Science, held in Boston, Mass., December 26-30.

The Scarab announces the offering of an annual prize for the best sketchbook presented at the end of the Junior year by any regularly enrolled student in the Architectural Department. The prize, which shall consist of a book bearing upon an architectural subject, shall be chosen each year by the Fraternity in conjunction with the head of the Department.

Professor H. A. McCormack attended the meeting of the American Institute of Chemical Engineers, held in Richmond, Va., the week of December 10th.

On the evening of December 23rd the scholarship students of the F. P. E. Department attended a banquet given by the Fire Insurance Scholarship Committee at the Union League Club. It is unanimously agreed that this event was a monumental success.

A course of lectures on the subject of approved methods of illumination, to be given under the joint auspices of the Armour Institute of Technology and the Illuminating Engineering Society, is announced. These lectures will be given at the rooms of the Western Society of Engineers on January 22-25 inclusive.

Two similar series of lectures have been successfully given some years ago, the first under the auspices of the Society of Illuminating Engineers and the University of Pennsylvania, and the second under the auspices of the Society and Johns Hopkins. However, both series were given mainly for the interest of the engineers. The forthcoming lectures introduce an innovation in that they are to be made principally of architectural interest. Doctor Raymond's address will open the meeting. Professor Freeman, and several Armour Tech Alumni will present papers.

As we go to press the report comes that the W. S. E. smoker, held on the evening of January 12th was a great success. One of the features of the evening, however, occurred after most of the guests had departed, when K Y W's midnight concert, with the Delta Tau Delta Syncopators and other U. of C. Entertainers began to come in. One of the group present called the Edison building, and everyone was gleefully surprised when the Magnavox announced, "A telephone call has just been received, stating that the concert is being listened to at a smoker of the Armour Institute branch of the Western Society of Engineers, held at the Scroll and Triangle Fraternity house. The program is coming in fine, and they are enjoying it immensely."

On Jan. 11th the first meeting of the Honor A Society was held for the primary reason of electing the officers for this year. Mr. Gilbertson, who was last year's president, graduated last spring, so O'Brien opened the meeting. The officers elected were:

President	Leo Walsh
Vice-President	Chester Andrzelczyk
Secretary	William O'Brien
Treasurer	William Desmond

At present there are nine members and several men from the baseball team who are eligible. Beside the above named, the membership includes:

E. E. McLaren
D. E. Rutishauser
E. A. Johnson
G. N. Schumacher
O. M. Spaid

SOCIETIES

R. M. Beckwith, *Editor*

ARMOUR TECH ATHLETIC ASSOCIATION

THE A. I. T. A. A. has been quite active the past semester. Besides handling a few assemblies, a Song and Cheer Contest was conducted. The Armory at 35th Street and Giles Avenue was secured. A football inquiry has been made. Letters seeking information were sent to forty of the leading schools of the country, twenty of which were of the same type of school as Armour. A complete report will probably be made by the first of February. A similar letter regarding debating and dramatics has been sent out. Plans for a banquet to be held at the close of the year are being made. The advisability of having an athletic dance is being seriously considered.

GLEE CLUB

During the latter part of last year Armour Tech received an invitation to join a group of the universities and more prominent colleges of the Middle West, whose object was to create a greater interest in the musical activities of the various institutions.

This gathering has developed into a temporary organization, the Intercollegiate Glee Club Association, which has scheduled a Competitive Concert to be held at Orchestra Hall on February 9, in which twelve universities and colleges will take part:

University of Chicago,	Armour Inst. of Technology,
University of Iowa,	Beloit College,
University of Illinois,	Grinnell College,
Northwestern Univ.	James Millikin University,
Purdue University,	Lake Forest College,
Univ. of Wisconsin,	Wabash College.

If this first concert proves a success, the organization will be made a permanent one, and will conduct contests similar to those held among the schools of the East.

WESTERN SOCIETY OF ENGINEERS

The program of the Armour Institute Branch of the Western Society of Engineers for the past semester has been of great interest because of the nature of the talks and the calibre of the men secured to give them. Beside the bi-weekly meetings, a banquet was arranged for January 12th. Among the entertainers on the program were Mr. Charles Hitchcock, Mr. Glennie, Mr. DeBra and Master Francis Goetz.

At the first meeting of the year Professor Phillips welcomed the new members and indicated the policy that a civil society should follow. Business for the semester was also discussed.

The second meeting was held on October 5th, and Mr. William Bethke gave a forceful talk on "The Power of an Idea." As former President of the Executive Club and organizer of the Legislative Reference Bureau of Colorado, Mr. Bethke was able to give his

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

During the past semester the A. I. E. E. has had many successful meetings, which have been attended by the members of other departments as well as those of the Electrical Department. Meetings are held at 11:30 A.M. on the first and third Thursday of each month, in the Electricity Lecture Room.

A few of the topics which have been discussed by various members of the organization are: "The City's Lighting System," "Electric Muffle Furnaces," "Sub-stations of the C. M. & St. P. Ry.," "The Practical Side of Engineering," etc. Besides these, there have been outside speakers on the following subjects: "Electric Welding," by Mr. Kenaud, of the Lincoln Electric Co.; "Trackless Train System of Industrial Haulage," by Mr. Klein of the Mercury Manufacturing Co., and other interesting topics.

The A. I. E. E. smoker was held at the Institute on November 16th. In the past year this has been an annual affair, but due to its success this year, it has been decided to make it semi-annual. The first speaker at the smoker was Mr. D. S. Chase, '20, of S. W. Straus & Co., who spoke on the subject of "The Engineer in the Bond Business." Mr. Chase has found that there is a growing demand for engineers in this line of work. Other interesting talks were: "Economic Waste," by Professor Freeman, and "Being Prepared for the Emergency," by Professor Moreton.

Considerable spirit has been shown in making the membership of the Junior and Senior Electricals one hundred percent. We also appreciate the loyal support that has been given by the members of the other classes, and look forward to the coming semester as an opportunity to do even more than in the past.

H. M. Piety, *Secretary*.

CHEMICAL ENGINEERING SOCIETY

The program of activities of the A. Ch. E. S. for this year follows the successful lead of previous years in having addresses from well known men of the industries as well as from our dear teachers. Last semester we enjoyed talks from: H. C. Dormitzer of Wilson & Co., who showed us the need of chemically trained men in the packing business; Professor Carpenter, who outlined a method of extracting radium from its ores; and from Professor Schommer, who in his usual stirring manner told us of the necessity of service to the community.

For the coming semester we have an equally attractive line-up and we are looking forward to it with pleasure. Our meetings are bi-monthly and all are invited to attend the talks.

The A. Ch. E. S. has petitioned the A. I. Ch. E. and, under the direction of Professor H. C. McCormack, expects to become a student branch of this society in the near future.

ARMOUR TECH Y. M. C. A.

At a meeting of the Armour Tech Y. M. C. A. on December 14th, the following officers were elected:

O. H. Marling.................... *President*
E. G. Wegner................ *Vice-President*
W. B. Douglas............ *Recording Secretary*

A Faculty Advisory Board consisting of President Raymond, Mr. Allison, and Professors Scherger, Wilcox, Perry, Tibbals, Phalen, and Amsbary was also named.

A definite membership drive is now under way, and a successful program for the coming year is assured.

ARMOUR TECH RADIO ASSOCIATION

W. E. Schweitzer................ *President*
F. J. Marco................ *Vice-President*
E. R. Sanborn.................... *Secretary*
C. E. Tweedle.................. *Treasurer*

The Armour Tech Radio Association is unusually active this year. The greatly increased popularity of radio brought new impetus to the progress of the Association and resulted in a large increase in membership. The organization is open to students of all courses, to anyone interested in radio communication and its possibilities.

We now have at our disposal a 250 watt tube, about which we have built a set. A bank of storage batteries provides a convenient source of filament current. We also have a motor-generator set capable of supplying direct current for plate potential at voltages up to 2,000 volts.

The circuit in use is the well known Hartley circuit.

Some preliminary difficulty has been experienced in securing the proper amount of radiation for a tube of the rating used. However an investigation is now in progress to determine the exact nature of this trouble, in order that it may be corrected and the range of the set increased.

We expect in the near future to have our operating schedule established and will be able to report further progress and extension of plans. Our friends may listen for us "on the air."

E. R. Sanborn, *Secretary*.

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talk from the viewpoint of an executive and an educator. Mr. Bethke first spoke on the various powers of ideas, and then explained how ideas can be made powerful. He emphasized the importance of the executive in carrying out the power of an idea and in developing to a greater degree the power of an idea.

On October 19th, Mr. Hugo Diemer addressed the society on the subject: "Opportunities for Engineers in Production."

On November 2nd, the Society listened to an inspirational address by Dr. Dignan, who took for his subject "The Tenth Man."

On November 16th, Mr. F. L. Ham presented "The Future of Engineering."

On December 7th, Prof. J. C. Penn presented a very interesting illustrated talk on "The Drainage of Holland."

H. W. Munday, *President*.

THE GUN AND BLADE CLUB

The Gun and Blade Club wishes to announce that it is entering its second season of existence at Armour and that a successful year is looked forward to by all the members. This club, composed of Federal Board men, is a chapter of a larger organization and is associated with like clubs in many schools and colleges throughout the Middle-west. In our program for the coming semester are a number of smokers and like "bach" affairs.

ARMOUR ARCHITECTURAL SOCIETY

The annual banquet and initiation ceremonies of the Armour Architectural Society, held on December 14, 1922, in the club room of the Art Institute, marked the addition of about thirty Freshmen architects into the society roll.

The speaker of the evening was Mr. Root, whose talk on landscape gardening brought home to the architectural students the importance of this art in relation to what is too often the architect's only consideration—the dwelling. The use and placing of terraces, trees, shrubbery, flowers, and lawns—the tools of the landscape architect—were explained in a manner that made the talk one of value as well as entertainment.

The parting shot was given by "Ted" Hofmeester, who, being safely graduated, came back to tell us what he thought of architecture. His remarks on modern architecture brought forth loud applause from the "modernists" amid the dropping of a few polite bombshells into the ranks of the "traditionalists." Although Ted departed immediately thereafter, the battle is still raging.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The year 1921-1922 proved to be a most successful one for the Armour Tech branch of the American Society of Mechanical Engineers. For this reason, we, the present members of the society, have chosen to adopt practically the same plan that has apparently benefited those men who are now graduated, and are out in the industrial or commercial world.

Meetings are held semi-monthly, on the first and third Thursday of each month. After the business of the meeting has been disposed of, talks are given by the members, upon any topic of engineering interest. The value of this training comes in accustoming our members to talking before an audience, and also in increasing their general information on engineering matters.

The meeting for the election of officers for the year 1922-1923 was held May 25th, 1922, and the following men named:

John V. Lizars.................. *President*
Geo. B. Stantial........... *Vice-President*
V. A. Gracunas................. *Treasurer*
L. A. Kaye...................... *Secretary*

By having the election at this date we had the cooperation of the Senior class in organizing, and were in a position to start the new school year with a regular meeting.

Our first meeting was held September 21st. Professor Gebhardt favored us with a short address, out-

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FRATERNITIES

R. M. Beckwith, *Editor*

TAU BETA PI

TAU Beta Pi announces the pledging of the following men to the Beta Chapter of Illinois. Eligibility requires that the numerical standings of the candidates must be within the first quarter of the class.

E. H. Christensen	Harold G. Love
Ora L. Cox	J. F. Lucas
Geo. D. Crane	R. O. Matson
Elmer A. Johnson	Chas. A. Misura

SCARAB

Happy New Year!

1922 has been good to us, and there is every indication of 1923 surpassing the benevolence of its predecessor.

Numerous "Get together" meetings with entertaining informal talks by the brothers on subjects pertaining to art have been and will continue to be some of the Chapter's chief sources of entertainment.

The Chapter is planning to offer a small prize in some line of architectural endeavor at the Institute in the near future. We are also concerned at present with the preparations for the coming National Convention which is to be held in Chicago.

BETA PHI

October proved to be a red letter month for Beta Phi. Several events of interest occurred between the housewarming on October 4th, and the annual New Year's banquet and dance on the night of December 30th.

In general, November and December were devoted to calculus, physics and other more or less essential indoor sports.

SIGMA ALPHA MU

The Old Year was properly ushered out and the New Year welcomed by a full program for Sigma Alpha Mu.

The Annual National Convention of the fraternity, held in Chicago this year, kept the members of this chapter busy. It may be added that our duties as hosts were not neglected.

TAU DELTA PHI

The Pyramid Club, which was recognized by the Executive Council on April 18, 1922, as a local organization, has been absorbed by the Tau Delta Phi Fraternity, permission for the change having been accorded on September 26th.

Tau Delta Phi, which was founded in 1910 at the City College of New York, comprises twelve chapters located at various colleges throughout the country. Chapter delegates have recently returned from New York, where the 1922 National Convention was held,

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SIGMA KAPPA DELTA

During the holidays Seaberg and Vaaler, the inseparables, Jeff Corydon, J. H. Watt, and Bob Van Valzah dropped in to reminisce and wish us a prosperous new year. A few days later, January 4th, we had the pleasure of entertaining Capt. Logan, Enright and Mahl, of the Notre Dame team, after the Tech-Notre Dame game.

A few dances, smokers, stag theater parties, etc., have kept the house busy and the boys in good spirits so far during the school year. The 1923 social program starts with a big house dance January 26th.

SCROLL AND TRIANGLE

The Scroll and Triangle Fraternity is glad to state that they are fully settled in their new home at 3305 South Michigan Avenue. The Fraternity took over this house, which was formerly Dr. Murphy's residence, last September. Due to the unsettled condition of the Fraternity's quarters, the social activity during the "rushing season" was limited to two smokers. A "Dads' Night" was held on the 10th of December and "Open House" was observed the night of the Frosh Frolic. A dinner dance was held New Year's Eve. Now that the fraternity has become adjusted to their new quarters, a more complete social program will be maintained.

RHO DELTA RHO

Six men have been pledged to Rho Delta Rho this fall, but not all of our time has been spent in "rushing" (See note following, by the Editor). Several smokers given throughout the fall months led up to a house party on New Year's Eve.

At the present writing we have settled down to the more serious aspects of life, with the mid-winter exams looming ever closer.

Editor's Note: The Rho Delta Rho scholastic average, which was omitted from the general list published in our last issue, is good enough to be given the necessary amount of space to be included herewith. The average of 88.0 percent was not exceeded by many of the fraternities. Congratulations are in order.

THETA XI

About the last of October it always seems that most people have an abundance or even a noticeable excess of pep—so in accordance with the ancient and agreeable custom of merry-making, the Annual Hallowe'en Dance held sway at the T. X. mansion on "Bull Mich." There was something happening every minute—and believe us, the happenings will not be forgotten for many a day. Thirty-eight men were accompanied by fair damsels—you can figure out the attendance on your slide rule.

On November 1st, twelve men pledged to Theta Xi—L. Dean Alber, Chas. W. Barger, Henry M. Harris,

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O. M. SPAID, *Editor*

THE FOOTBALL QUESTION

By

JOHN J. SCHOMMER, *Director of Athletics*

SEEMINGLY there has been considerable excitement created about football if one believes what is read in certain newspapers. In fact conditions are depicted so bad that future athletic intercollegiate competition is in jeopardy at some of the large universities.

This agitation has taken place about the same season year after year and is usually started by baseball writers of celebrity. The season between the close of baseball and its opening in the spring is a difficult one for editors to find work to keep their high priced baseball writers busy. So they are turned loose on intercollegiate athletics from about the last of October to the time when it is necessary to start on the spring baseball training trips.

"Bad news travels quickly," and so if some professional charges against star athletes can be uncovered, or some radical professor's views aired or high price coach talk may be hurled at some low salaried professor, who then "spouts up," the fire is on just as surely as if the reporter sets fire to some buildings. The conflagration is started and he sits back to write up the news. In other words he makes sport news to supply the lack of sport news.

Eliminating the very few colleges in the country that openly hire athletes to build teams that tour the country for advertising purposes, there is very little, wrong with modern football. The big fault is, that not enough students can be induced to participate in this red blooded sport.

Few will dare go on record and say that Western presidents, coaches and faculties of colleges go out and buy players. Alumni of some institutions are said to have raised money to defray athletes' expenses while in college. This may be so. However, this may be prevented. A good competitive sport should not be thrown out of college life any more than chemistry or mathematics should be thrown out because some student or students cheated in examinations. Professors have committed burglary, bigamy, suicide, and every crime on the calendar. The so-called intellectuals, with all their training and mature years, go wrong occasionally. Why throw out the particular courses they taught?

One of the so-called evils of college athletics is the high priced coach, if the low salaried disgruntled professor is listened to. Why is high salary an evil? The successful coach is bid for as is the successful professor. When the successful professor has made good and aided his science he gets publicity; when he gets pub-

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SWIMMING

It has required a long time to discover that we have fish at Armour Tech, but we do have them for certain.

At the first call for swimmers about thirty men responded. Professor Schommer gave a few general instructions and adjourned the meeting until the tryout at Bartlett Natatorium the following Monday. At the tryout the famous Midway Coach gave each man his personal attention. Few of our men have the advantage of previous coaching, so require a large amount of instruction, for, as Coach White says, "If you have perfect form in swimming, you cannot help but be fast."

Practice sessions are held on Monday and Thursday evenings from 5:30 to 6:30, and on Friday afternoons. So far, no team has been picked, but all the candidates are working hard. Several of our men have been swimming for some of the well known local clubs, and have shown up exceptionally well. With these as a nucleus, the prospects are that we will have as strong an aggregation as could be asked for, when the final selection of a representative team arrives.

FALL GOLF TOURNAMENT

Next to the tennis tournament held this fall, the golf tournament had the largest number of entries and was relatively as interesting. Because of the bad weather in the early part of the season many of the matches were played under considerable handicap and the final matches were delayed several weeks. Those in the semi-final were Frink, Dunlap, Bates and Joseph. Dunlap and Joseph played off the final, Dunlap winning all the honors.

Indoor golf practice may be resorted to and a good team should be put in the field next Spring.

WRESTLING STARTED

Progress toward the building up of a wrest ing team for Armour is now being made quite rapidly. Under the direction of Coach Smith, several workouts have already been held and from now on the training grind for prospective candidates promises to be in earnest.

So far several good men have showed up, but there is still opportunity for good men in several weights. The heavyweight class has two able men in H. Hedges and Ivanauskas. Light heavy, ranging from 158 lbs. to 175 lbs., has no representative as yet. Several good men in the lower weights are working out, but more representatives for welter, middle, and light heavy are wanted.

Coach Smith desires to whip the team into shape as soon as possible and is confident that meets with other institutions will be held in the near future.

THE FOOTBALL QUESTION

(*Continued from page 54*)

licity the job hunts for him and one university after another attempts to buy his reputation. When jobs hunt the man he is bid for. This raises his salary accordingly to the ability of the professor to sell himself. Also the professor's ability as teacher when not a researcher is often difficult to ascertain. His job is more secure than the coach's. Therefore, a higher salary is justified for the coach. It may be added here that the modern trend is to make faculty members of coaches at lower salaries but with the added feature of security of job.

Football is said to take so much of one's time that little is left to study. If rightly conducted two hours a day is sufficient. That is not more than any professor in college expects on the major subjects. The only difference is that if the student doesn't "get the stuff" from the professor, the student is "flunked," and if the student doesn't get football the coach is "flunked."

Publicity is given to the fact that football is highly commercialized. What is meant by this? I don't know. But I do know that students and faculty members may see games at moderate cost at most universities by buying season tickets.

The public is made to pay, and the public is willing to pay. I venture to say that if the gates were thrown open and everybody invited at no cost and that no write-ups were given the games, very few people would attend. Is this desired? The game and the training for it is not less desired merely because thousands are excited and not hundreds.

Others say the season is too long. Three or four games are enough to play. But these advocates say nothing about rowing. This sport is practiced nearly nine months with very expensive equipment. Basketball season is six months. Baseball season is started in January and goes to the middle of June. Track season starts with the first week and ends in the middle of June. Why then attack football only? I notice quite often that men are dropped from athletics when falling below in studies. I never heard of a young man failing in studies being brought before "the carpet" and told he must quit his eight-hour-a-day job when working his way through college. But it happens quite often that an athlete is told to drop athletics or get out of college.

Athletics rightly administered is beyond a question invaluable in an undergraduate's life. It teaches too many valuable qualities not obtained in class work to be thrown lightly aside: manliness, unselfishness, teamwork, sportsmanship, fight and the love of a clean body. What is meant by rightly administering athletics? Everybody made to compete in some branch of games. See to it that students maintain an average grade scholastically; don't hire professionals; and play the game for the game's sake, keeping in the background that the only thing desired is the championship.

BASKET BALL

THE basket ball schedule for this year was preceded by several practice games with small institutions about the city. On Dec. 15th the first schedule game was played with Marquette University of Milwaukee. Despite the fact that the Junior Dance was on the same night, there was quite a large crowd of rooters out to see the game. The first half was fast and many times Armour rushed the ball down the floor but was unable to locate the basket. In the second half the Marquette guards usually got the ball at the jump and by a clever passing game were able to gain quite a lead.

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lining the object of the society, which is to enable men to talk before an audience, to use good English, and to overcome self-consciousness. His talk was greatly appreciated and it contained excellent advice for all.

With the first half of the year started in such a manner, it seems very probable that this will be one of the brightest and best years the society has ever experienced.

L. A. KAYE, *Secretary.*

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Chicago to points of consumption. The great mass of wheat is produced west of Chicago and consumed east of Chicago. The price paid by grain dealers at the various points west of Chicago where wheat is produced, is day by day the Chicago price less the freight from the point of purchase to Chicago. The price of wheat east of Chicago is the Chicago price plus the freight from Chicago to the given point. In neither case does the cost of producing the wheat west of Chicago or the cost of producing the wheat east of Chicago fix the price. The market price at Chicago fixes the price in both localities.

The price of sugar furnishes another illustration of the subject. The United States does not produce sufficient sugar to supply its needs. In consequence, large quantities of sugar are bought in Cuba. The prices for sugar which rule in different parts of the United States bear a direct relation to the prices of sugar at seaboard points, such as New York City, Baltimore and Galveston.

It may be laid down as a general rule that the district in which the greatest quantity of the products named or other products similarly affected by market conditions are produced or marketed, establishes the market prices for such products and becomes a basing point for the prices of such products in other districts.

It appears that the Western Association of Rolled Steel Consumers is exploiting a desire and purpose to provide, preferably by government regulation, prices for steel products which they purchase upon some basis more favorable to them than the prices which prevail under normal market conditions. As far as we know, the Western Association of Rolled Steel Consumers is not advocating a like government regulation of the prices at which its members sell their respective finished products.

It is hoped that the above statements will supply the information which the readers of your paper desire.

Yours truly,

E. J. BUFFINGTON,
President.

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Duane L. Heller, Martin C. Hussander, Chas. D. Johnson, Philip F. Kingsley, H. Walter Regensburger, Murray Russell, Robert C. Sisson, Truman St. Clair, and George E. Woodfield.

Robert A. Smith, Jr., James P. Dunlap, Lionel C. Senescall, and Duane L. Heller were initiated on December 9th.

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where he visited St. Paul's, Westminster Abbey, and the Houses of Parliament; these he found the most inspiring of all London architecture.

In many of the smaller cities and towns of England he found even more to admire than in London itself. He says, "We spent several days in Salisbury, Wells and Winchester, St. Albans, Oxford, Canterbury, Stratford-on-Avon, Wenson, and Eton. I simply loved Ann's cottage at Stratford, and hope to develop a thatched roof on my home when I get back to the States; I think it simply wonderful. I have collected 300 cards and photographs of England and a wonderful collection of Canterbury."

At the time of writing his last letter Connor was at the Hotel Jacob in Paris, but expected soon to have a studio of his own. His present plans are to remain for some time in Paris as a student. He expects, however, to visit as many places of architectural interest as possible before returning home.

Joseph Karlson, 1920, spent some time in the office of Holabird & Roche, Chicago, after his graduation. He and Wm. J. O'Connor, 1920, are now abroad attending the School of Fine Arts in Paris.

A student in the department of architecture who exhibits exceptional talent is able, during his Senior and Graduate years to do work of sufficient merit to exempt him from the first preliminary of the Paris Prize Competition and admit him to the second preliminary competition. This competition is conducted by the Beaux Arts Society of Architects, and architects from all parts of the world take part.

H. K. Bieg, '21, and Jerry Loebl, '20, by reason of good work already done, have been admitted to the second preliminary competition without the necessity of taking part in the first preliminary.

Several Armour men in Detroit have recently made application for a charter for the Detroit Branch of the Alumni Association of Armour Institute of Technology. We are advised that this application has been acted upon favorably by the Board of Managers, so that the Detroit Branch is now officially in existence. The officers of this, the first branch of our association to be formed, are:

H. S. Ellington, '08.............. *President*
W. G. Hoy, '05............ *Vice-President*
C. L. Ott, '16.......... *Secretary-Treasurer*

The Alumni Association is to be congratulated upon the formation of the Detroit Branch, and upon the group of hustling Armour men there who have made it possible. As time goes on and the number of our graduates increases, other branches will doubtless be formed. It is hoped that Alumni in other cities will emulate the example of the Detroit men, for such branches will help wonderfully in strengthening our whole Association.

The Institute basket ball team expects to visit Detroit in February, and the Detroit Branch, we understand, hopes to act as their host upon that occasion. This will no doubt be much appreciated by the members of the team, and will also serve to put the Detroit Alumni into closer contact with the Institute and with the present student body.

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and engrossing. Unless we can get into the business more men who are trained particularly for it, we will go backward.

Armour Tech graduates are taking a high position in the insurance world. They are the men who are commanding the money. They have a knowledge that their fellows do not possess. The course at Armour Tech leads directly into fire insurance work. When a man graduates he at once becomes useful to an insurance company. This is not the case with many college graduates. They have to pursue a course in practical training before they are worth much to their employers. A graduate from the fire protection engineering course is amply fitted to assume an important position, and immediately he is able to give value received to his employers.

I have emphasized the value of this technical training. I do not want to underestimate it. It is the real *pièce de resistance,* so to speak, of one's working tools. This knowledge that he gains becomes increasingly essential.

I do, however, want to leave one admonition. The technically trained man possessing nothing else may become decidedly narrow and inelastic. Fire insurance business brings its people constantly in contact with the public. It is pretty much of a human business. It has to deal with the possessions of men. They are vitally interested in the property which is indemnified. Therefore, the fire protection engineer must be also a human engineer. He must love men, must know how to meet them, must know human nature and must be a student of psychology. It is a big advantage to a fire protection engineer to have the salesmanship characteristics. It is up to him to satisfy his customers, so to speak. The fire insurance policy holder should realize that he is dealing with someone who can see beyond the technique of his own business. The fire insurance officials *look to these trained young men to popularize their business. They cannot bring it into public favor without the ability to meet and treat with men.* The fire insurance engineer must be a broad gaged, all-around, elastic man who can give and take. The human side of fire insurance is to me a most interesting phase of the business. *When the Fire Protection Engineer has the faculty of adapting his technical knowledge to practical demands and is able to leave a good taste in the mouth of people with whom he is transacting business, he has a combination that is a world beater.*

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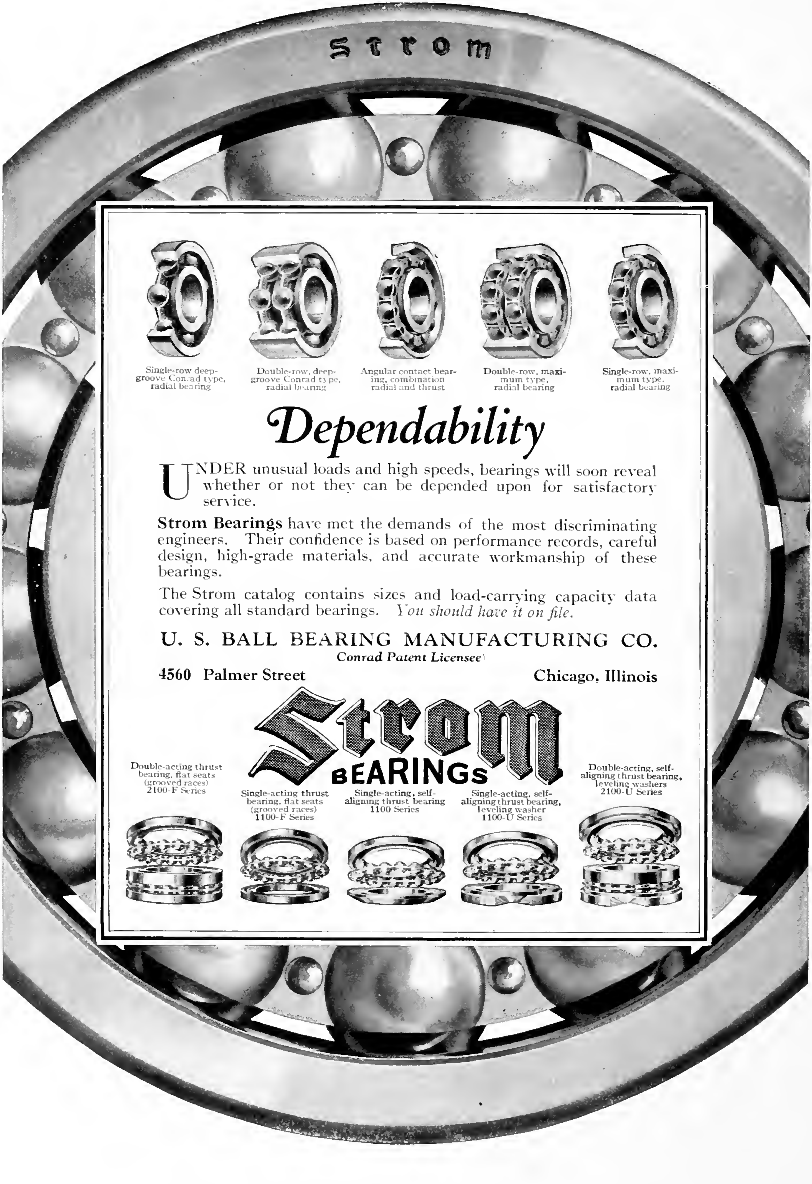
with reports for the past year showing marked growth and progress, and an extremely encouraging outlook for 1923.

During October and November the customary smokers were held, and three men were pledged. Our midwinter banquet, to be held in January, is something to which we are looking forward.

We are ready at all times to further the interests of Armour Tech and it is our hope that our co-operation will be asked in any enterprise which will benefit the college.

The scholastic standing of the "Umen" was not received in time for publication in the November issue of the Engineer. The average of the grades of its members is 89.3.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BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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Statement of Ownership

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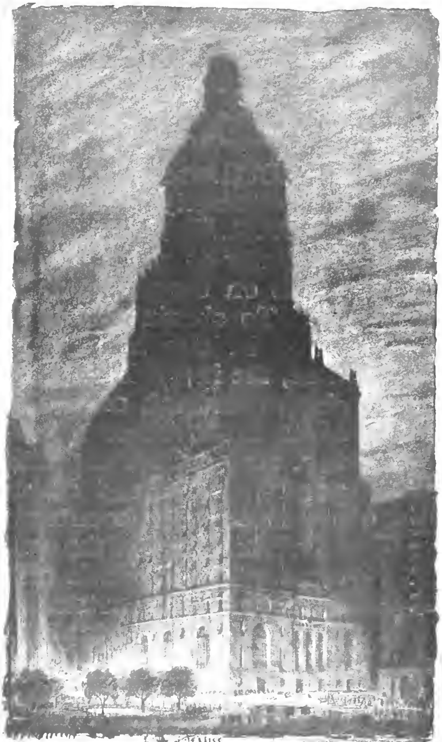
(*Signed*) LESTER E. GRUBE.

Sworn to and subscribed before me this 8th day of November, 1922.

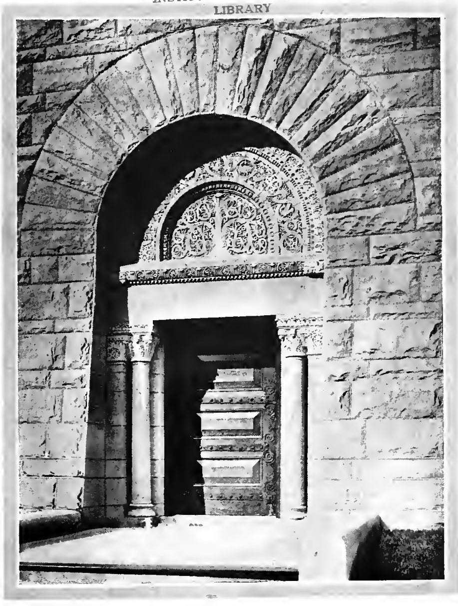
(*Signed*) GEO. S. ALLISON.
Notary Public.

CHICAGO, November 8, 1922.



The Armour Engineer

MARCH 1923



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Advertising Index

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THE ARMOUR ENGINEER

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COST PLUS VS. COMPETITIVE BIDDING

By R. M. Henderson, '02.

Vice-President Dwight P. Robinson Co.

R. M. Henderson, '02.

SINCE the war there has been much criticism of the "cost plus" plan under which a great deal of emergency construction work was done, not only for the government, but also for private enterprise.

To this form of contract and what it stands for has been charged every sort of abuse from conspiracy down through the various degrees of graft, incompetence and gross negligence to a less malicious but equally harmful failure to conserve the interest of the client by prosecuting the work energetically.

As engineers you are likely to be instrumental in the carrying through of construction enterprises and should be well informed concerning the merits of the different forms of contract which may be applied to such operations. If you will take the trouble to do a little research work, you will find that the periods of construction activity that have attended all of our previous wars have been accompanied by claims of graft, collusion, conspiracy and all the other myriad forms by which the government has been supposedly exploited outrageously for the benefit of those who furnished materials or constructed buildings, fortifications, railroads and the like.

In earlier days the so-called cost plus contract was less in vogue than during recent times and most of the contracts were placed under a nominal or actual competitive condition and after calling for lump sum bids covering work described in greater or less detail by plans and specifications. The abuses that accompanied this older form of contract were, if anything, greater than those ascribed to the cost plus contract of more recent years, and the abuses were made possible through collusion in bidding, unwarranted extras or lax interpretation or enforcement of specifications.

A very long and very sordid story could be written about each of these and other means used for defeating the intent of the contract document, but it would only serve to crystallize in your minds the simple fact that the form of contract is of far less importance than the character of the contractor. Given a dishonest contractor, the owner is going to be exploited to some degree under any form of contract. Under the lump sum form the contractor is not under any obligations to expose his books or any of his private documents in connection with the contract to the scrutiny of the client and the attempt of the dishonest contractor to take advantage of the owner is aided materially by this fact. He has the opportunity of resorting to sharp practice in the interpretation of plans and specifications to secure extras where the intent or detail is not iron clad and specific. The architect or engineer has not yet been born who can prepare a set of plans and specifications that is not in spots susceptible of questionable interpretation. Comparatively few owners are sufficiently expert in the reading of plans or specifications to fully visualize the thing which is set forth, and as the work progresses and the plant or building takes shape, the owner finds many things that are not as he would like to have them and numerous changes are then brought in for consideration.

Once a contractor is well started on a job it is impractical, difficult and expensive to discharge him and bring in another in his place. This is well understood among contractors and is the foundation of that great source of revenue, "extras." Every change required by the owner after the contract has been signed can be assessed at almost anything the contractor wishes to ask and the ability of the architect or engineer to refuse has distinct limitations. Where the contract is placed on a unit price basis under which work is to be paid for at so much per unit, the device known as unbalanced bids is the favored form through which the contractor realizes unreasonable and abnormal profits. He takes advantage of what may be a superior knowledge of some of the limiting conditions to raise his unit price on some item on which he has reason to believe there will be a great deal of extra work, and to reduce abnormally the unit price on one or more other items of lesser consequence. The result of this in the original bidding is frequently to make the total of all items compare favorably with other competitors whose bids were not unbalanced, but as the work proceeds the vicious effect of the unbalanced bid becomes apparent while the owner has no recourse.

Aside from these phases of the lump sum contract which have to do with the unscrupulous contractor, there are other disadvantages in which dishonesty is not a factor. A comparison of bids of anything but the simplest job of small dimensions will show great differences of opinion among contractors as to the cost. It is not uncommon to see the difference between the high and low bid equal 100% of the low bid and variations as great as 50% of the low bid are usual. This fact in itself should be evidence to any sane mind that there is reason for the uncertainty that appears in estimating the cost of a large and complicated operation.

The lump sum contract purports to say to the owner that the contractor will build the project under contemplation for a fixed amount of money, the contractor undertaking to carry all of the hazards connected therewith and agreeing to complete the work by a given date. The assumption of the hazards constitutes the basis on which the more successful contractors predicate their relatively high bids. These hazards which the contractor assumes are magnified in all of the discussions and the owner is argued or frightened into a state of mind such that he is glad to be able to get out from under the risks involved and to secure what he regards as a guaranteed price for his job.

No greater misconception of the facts exists than this carefully fostered belief in the integrity of the lump sum bid. Impartial examination of the comparison between the original bids and the final costs of a hundred jobs costing half a million dollars or more will demonstrate conclusively that a lump sum or guaranteed bid is generally materially less than the actual cost. This is without including extras occasioned by actual increase in the scope of work beyond that covered by the bids. If a job is being figured during a period of rising material and labor prices, something has to be added to protect the contractor against the actual rises that will take place until such time as he can complete the purchase of all materials and place labor contracts. In many cases this period will be from three months to a year and the experience of the successful contractor is the only basis for estimating the correct margin for this period. Obviously he will try to provide more than is actually required, which means that the owner has paid excessively for the guaranteed price. If the expected rise does not materialize and the market declines during the period of construction, the contractor secures all the benefit of the decline in prices as additional profit. These are a few of the reasons why in peace times a lump sum contract only guarantees in the average case that the owner will pay more than the actual worth of the work done. It should be clear that under the pressure of war time or any other emergency condition, the interjection of dishonesty and incompetency largely multiplies the probability of the owner's being compelled to pay more than his work is worth.

The principal agrument advanced against the cost plus plan is that the contractor takes no risk of loss and therefore lacks the incentive necessary to secure maximum efficiency and consequently minimum costs. The variations of this thought prevade a good many of the details entering into any operation, including the assertion that even the workmen get to know that the job is on the cost plus basis and they, therefore, slack off and fail to deliver as much for a day's pay as they do to the lump sum contractor whose own dollars are at stake and who, therefore, drives them harder. There is practically no other objection of serious importance, as any fair analysis will immediately show that all of the other factors entering into the discussion show the balance heavily in favor of the owner on the cost plus plan.

This one major objection can be answered by the owner, if he selects as his contractor one whose ability and integrity have been proved by past performance. The cost plus contractor is dependent upon a good past record to a greater degree and in an entirely different sense than is the case with the lump sum contractor. It is an easy matter to correspond with a sufficient number of the contractor's former clients to develop whether or not his performance has been such as to warrant an owner's placing himself in the contractor's hands.

In most commercial organizations it is a function of the engineer to advise concerning the selection of contractors who are to build. This is equally true whether the engineer is an outside consultant or is regularly employed within the organization. In either case it is his business to verify, by rigid inquiry, the merits of the bid for confidence submitted by the contractor. Having satisfied himself on this score, he should select his contractor in precisely the same manner that he selects his architect or designing engineer, with secondary regard to competitive estimates or bids. If the right architect has been selected and the right contractor chosen, the most satisfactory results will be obtained, regardless of the form of the contract or estimate of cost. The nature of the work should be allowed to govern the type of contract. If it is a simple and comparatively small enterprise, a small list of contractors can be invited to submit competitive lump sum bids. If the job is more complex, but still of relatively definite scope, there will be found a limited number of contractors among whom one can be selected who will name a fixed charge for his services for carrying on the construction work at actual cost. If the work is still more complex and conditions are such that its scope can not be closely defined, or if great uncertainties exist in a physical sense by reason of foundation conditions, weather, labor difficulties or extreme time requirements, the procedure should be to select out of the available contractors one in whom there can be unquestioned confidence, and arrive at a working basis on the cost plus percentage plan.

Of the three plans, the second is the best for the majority of industrial and power enterprises. Among the positive advantages that accrue to the owner under either the second or third methods may be enumerated the following: The owner or his representative in collaboration with the contractor will handle the purchasing, either through the owner or through the contractor or both, in order to take advantage of the particular purchasing ability that either one may pcssess in connection with different materials required. This insures rock bottom prices and the owner's paying only the actual cost of the material and paying no allowances for possible rises in the market (as in the case of the lump sum general contract), and getting the benefit of any drop in prices between the time the work is ordered to proceed and the date when the material can be purchased.

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THE MISSION OF CULTURE

By Prof. George L. Scherger.

Prof. George L. Scherger.

ONE of the most valuable lessons to be learned from the study of history is that of the unity of history. History knows of no breaks or gaps. The stream of events moves ceaselessly on. Each epoch is but a link in a long chain. Each generation stands upon the shoulders of the preceding one. Each age and nation hands the torch of culture to its successor. The torch does not go out, but grows constantly brighter.

We, the children of this twentieth century, are the heirs of the ages that have passed by. We are indebted to the past for our present civilization. If our intellectual horizon is wider and our mastery over nature, greater, than that of our ancestors, it is because we did not need to work out anew the great problems of life, but could utilize the experience and wisdom of the past. Our age, because it is the latest, is able to build upon a broader and more solid foundation than all others. In this manner alone does progress become possible. Each new age and people contributes its share, however great or small, to civilization.

It is one of the aims of culture to put the individual in possession of the heritage which has been bequeathed to him by the past. We may live over again the past, recapitulating in our own life, the development of the race. The triumphs won by great men in days gone by were won for us. We may enter into their nature, we may dream their dreams and think their thoughts over again. Homer will take us to Troy and Cæsar to Gaul. Plutarch will show us wherein true heroism consists. Froissart will transport us back to the days of feudalism and chivalry. We may converse with Socrates, Milton, Goethe or Emerson. These men are not dead. They live in their works. They are now our humble servants. We may know them more intimately than most of their contemporaries. By studying the civilization of Greece and Rome we may in a sense become like the Greeks and Romans.

The people of the Middle Ages looked upon life merely as a preparation for death. Existence in this world being but a small arc of the circle of eternity we must not lose ourselves in worldly pleasures for we are but pilgrims here below. The mediæval saint strove with unflagging zeal to prepare for heaven. He lashed his body until the blood flowed down his back, he recited numberless prayers, he fasted until he became like a hollow-eyed corpse. Existence was to him a slow death. When he lost interest in everything that savored of life here below he reached perfection. His life was a constant struggle with the natural man, whose desires and passions must be extirpated. The saint must die unto this world, in order to obtain the bliss of that to come.

In marked contrast to this view, with its negation of the world and nature, stands the Greek conception of life. The Greek felt the joy of living. His world was a world of sunshine. All Nature was alive. Nature was to him a fostering mother, not to be feared but rather to be loved. He endeavored to learn Nature's secrets; to live in closest communion with her. The powers and inclinations she has implanted in us are not to be repressed but rather unfolded. The Greek endeavored to live the perfect life, which to him was the life according to Nature. He lived with zest, wishing to make the most of himself, to crowd into the brief span of existence the maximum of experience and joy.

Our modern age must combine the Christian and the Greek views. Without losing sight of the truths Christ inculcated, without forgetting the mystery of death and the hereafter, we must not fail to see that this world and life has a right to engage our interest and attention. We must first learn to live. The best preparation for death is the preparation for life. We must listen to the call of the *Here* and the *Now*. Our age has a longing for greater fullness of life. The problem which is before us is that of trying to make this world a better place to live in than it is now and to make man more fit to inhabit it than he is at present.

Every age acquires an increasing mastery over Nature. There is less of misery in the world today than ever before. The human biped is today something less of a brute than he used to be. He has done some rather wonderful things in the past and may look at least somewhat hopefully into the future.

But life is becoming more and more complex. This increasing complexity necessitates increasing preparation for life. The need of discipline and training was never felt so deeply as it is today. The prizes of life do not fall into the lap of the dreamer or the sluggard, but are seized by him who is active and wide-awake. Never was the struggle for existence so keen as now. While the openings for work are numerous there is no dearth of men to fill the vacancies. The weak fall behind, the strong forge ahead. The weeding-out process goes on at an almost cruel pace. The world is crying for trained men to become teachers, engineers, doctors, lawyers, and preachers.

The young man of today must have a purpose. He must know what he wants to be and then bend all his energies toward reaching his aim. He must be a spe-

cialist. "In self-limitation," says Goethe, "true mastership shows itself." In order to succeed in building a large tower, the foundation must be deep and strong. Of course, what President Jordan said about wasting a $5,000 education on a 50 cent boy is true, yet everybody can do something better than anybody else, if he can but discover what especial gift Nature has bestowed upon him.

How much energy is wasted simply because it is misdirected! Niagara needs to be harnessed in order to be of use. How many waste a lifetime waiting for opportunity, trusting to luck, waiting for a rich uncle to die, instead of relying upon themselves. "Every one is the smith of his own fortune," says a good old proverb. Success is coveted by all, but few are ready to pay the price necessary to obtain it.

"The heights by great men reached and kept,
Were not obtained by sudden flight;
But they, while their companions slept,
Were toiling upwards in the night."

When one of Edmund Burke's brothers heard him deliver his maiden speech in Parliament he said to a friend: "I always thought Ned had all the brains in the family," but after a moment's thought he corrected himself by adding, "I see how it is. While we were sleeping and playing he was working and studying." No one can reach the heights without climbing. Merely gazing at the top and longing to be there will not get you there.

But we are not mere machines, intended to grind out work. We must get more out of existence than a mere living. Man does not live on bread alone. Preparation for life includes more than the mere training to earn bread and butter. We must not only have a calling, a vocation, but many other interests besides We must lead an inner life as well as an outer. The richer our inner life, the greater our usefulness, the more valuable does existence become. That man is to be pitied who cannot derive pleasure from the reading of a good book, from conversation with his fellows, from the contemplation of art, from listening to good music, or even from following his own train of thoughts. The nature of one's amusements, the manner in which he spends his spare moments or his vacation is one of the best indexes of his character.

Our most glorious opportunity in this world is that of infinite self-development, of acquiring a broad culture that unfolds what is best in us. This means the education of the entire man—body, mind and soul. Personality is the most valuable thing in the universe because it is never duplicated. As the sculptor upon seeing the block of marble saw an angel there, so every person is a bundle of possibilities.

Back of the work is the man. The little man cannot do anything great. Being something is the prerequisite of doing something. Our personality colors our thoughts, our words, our deeds. Beethoven has written his biography in his symphonies. The whole man with his ideals, his struggles, his defeats, his triumphs, is there. Culture is self-development. It aims to raise our powers and faculties to their highest efficiency. Its goal is the perfection of man. Culture shows what man can do along the line of improving that with which nature has endowed him. It does not put a load upon his shoulders, but gives him power, light and consolation. Culture enriches our life and increases our usefulness. It refines our nature and makes us increasingly human. It makes our sensibilities keener and our pleasures more exquisite. It enables us to look at the world with the poet's eyes and behold its mysteries revealed by the light of science. How different the world seems to a Wordsworth, a Turner, or a Humboldt than it does to the South Sea Islander. The cultured man crowds more experience into one year than the savage does into a lifetime.

Culture takes hold not only of one side of our nature, but of the entire man. It includes the harmonious and symmetrical development of our intellectual, emotional and volitional powers. None of these should lie dormant. We need breadth of culture as well as intensity. We should be alive every moment of existence. Every experience should enrich us. Culture can render us affluent.

That vision which culture can give will enable us to see things in the right perspective and to correct our own eccentricities. Culture teaches us our own modest place in the universe. It saves us from pedantry and conceit by showing us what the relation is between our work and that of others. Newton's con tributions to knowledge, vast as they seem to us, appeared to him so insignificant compared with his vision of the comprehensiveness of truth that he likened himself to a boy picking up pebbles along the seashore. However, culture gives us a wide range of interests and affinities. Warped as we are by our own special gifts and inclinations we need the corrective of a broad culture, which becomes all the more necessary with our tendency to extreme specialization.

It is true that each of us has a particular task to perform. As every one of us is different in his makeup from every other, so no two persons have the same mission or can do the same work. Each of us should be an individuality, a personality. But our work must absorb our whole nature. It must not be mere routine. We must have a longing for greater fullness of life. While we have a vocation, a calling, we must also have avocations.

We must concern ourselves about things outside of our own specialty. Much nonsense has been spoken about having too many irons in the fire. It is very surprising how closely the various fields of knowledge are related to each other. Geology can not be studied apart from chemistry, astronomy and biology. The philosopher needs to know as much about science as the scientist does of philosophy. Ranke was able to become the historian of the Reformation because he had first made himself at home in the field of theology. Goethe's work as a man of affairs and his researches in botany and mineralogy did not impair, but rather enhanced, his poetic productivity. Michael Angelo was scarcely less great as a sculptor and poet than as a painter. Extreme specialization often defeats its own ends. The great work is always done by the master who has vision rather than by the mere craftsman.

MEASURING THE FLOW OF FLUIDS ELECTRICALLY

By J. M. Spitzglass, '09

and

E. H. Freeman, '02

The application of electricity in measuring the flow of steam or other fluids has been in use a number of years, and its advantages are well recognized. The electrical method gives relatively high accuracy and permits the locating of the indicating instruments in places that are convenient but which may be remote from the points where the measurements are made.

E. H. Freeman, '02

The object of the present discussion is to outline the fundamental features of a system which has been applied for several years, giving particular attention to the principles employed to make the use of electricity possible and to a new electrical integrating meter for measuring the total quantity of fluid that has passed a given point.

The basic principle of the Republic Flow Meter is demonstrated diagrammatically in Figure 1. The U-tube partly filled with mercury is made to balance the impact pressure of the flow in the pipe by the corresponding rise of mercury in the low pressure side of the tube. The mercury column forms a part of the electric circuit as shown in the figure.

The electric circuit contains a fixed external resistance R_1 in series with a variable internal resistance R_2, an electro-motive force E, a conductance indicator A, a conductance integrator or integrating mho-meter W. In the Contact Chamber C which forms the low pressure side of the U-tube, there are a number of conductors of varying lengths placed above the mercury column, and as the mercury rises it makes a contact with one conductor after another. The variable resistance R_2 is subdivided by these conductors into resistance steps corresponding to the varying length of the conductors so that the rise and fall of the mercury column varies the amount of resistance and the corresponding amount of electric conductance in the circuit.

The basic principle accordingly involves the laws governing the flow of fluids through pipes along with those governing the conductance of electricity through a given medium. The relation of the quantities involved is much simplified by the development of the conductance integrator, which makes possible the measurement of the flow of the fluid in the pipe by measuring a conductance in an electric circuit of the meter.

The relation between the pressure and the velocity of fluids in its simplest form is represented by the well-known equation

$$\frac{v^2}{2g}\gamma = P_2 - P_1 = hw$$

$$\text{or} \quad v = \sqrt{\frac{2g\,(P_2 - P_1)}{\gamma}} = \sqrt{2gw}\sqrt{\frac{h}{\gamma}} \qquad [1]$$

J. M. Spitzglass, '09

where v and γ represent the velocity and density of the fluid; $(P_2 - P_1)$ the equivalent differential

pressure; h the height and w the density of the liquid column balancing the differential pressure of the flow.

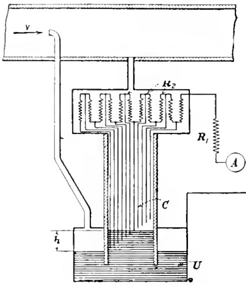

Figure 1.

This differential pressure hw may be obtained, as shown in Figure 2, either directly by balancing the difference between the dynamic and static sides of a pitot tube inserted in the line, or indirectly by balancing the difference between the high- and low-pressure sides of a venturi tube, nozzle tube or orifice plate. In the case of the pitot tube the differential column in the U-tube represents the flow or motion existing at the given section of the line, but in the venturi tube, nozzle or orifice, the column obtained represents the *change* of motion produced by the artificial obstruction of the passage at the given section of the pipe.

In any case, however, the relation between the differential column thus obtained and the velocity of the fluid in the pipe may be represented by Equation (1), provided there is introduced the experimental coefficient derived for the given tube or orifice. Thus, in general,

$$v = c\sqrt{2gw}\sqrt{\frac{h}{\gamma}} \qquad \textbf{[2]}$$

The volume of the fluid, Q, passing per unit time through an area A is given by the equation

$$Q = Av = AC\sqrt{2gw}\sqrt{\frac{h}{\gamma}} \quad \ldots\ldots\ldots \textbf{[3]}$$

the corresponding weight G per unit of time is

$$G = Q\gamma = (A\sqrt{2gw})\,C\sqrt{h\gamma} \ldots\ldots \textbf{[4]}$$

and the total weight M, for a given period of time is

$$M = \int G\,dt \ldots\ldots \textbf{[5]}$$

The relation between the mechanical quantities just set forth and the electrical quantities used in making the measurements are established by construction, as indicated partially in Figure 1. If S is the conductance of the circuit that is varied by the change in the height h, of the mercury column, then it is possible to make

$$S = \frac{(A\sqrt{2gw})\,C\sqrt{\gamma}}{U}\sqrt{h} = \frac{G}{U} \ldots \textbf{[6]}$$

in which U = a constant, the ratio of G to S.

Denoting by S_m the conductance of the circuit corresponding to the maximum rate of flow, G_m, which in turn corresponds to the maximum differential head, h_m, then

$$U = \frac{G_m}{S_m} = A\sqrt{2gw}\,C\sqrt{\gamma}\frac{\sqrt{h_m}}{S_m} \ldots \textbf{[7]}$$

as shown diagrammatically in Figure 1. S_m is obtained when R_2 is short circuited. Hence

$$S_m = \frac{1}{R_1} \ldots\ldots\ldots \textbf{[8]}$$

and

$$U = (A\sqrt{2gw})\,C\sqrt{\gamma}\,R_1\sqrt{h_m} \ldots\ldots \textbf{[9]}$$

Combining equations **[6]** and **[9]** gives

$$S = \frac{1}{R_1}\sqrt{\frac{h}{h_m}} \ldots\ldots\ldots \textbf{[10]}$$

It is interesting to note that h_m represents the relative value of the differential column for a given rate of flow, and 100 h_m is the percentage variation of the head in any given meter. From equation **[10]** it follows that in order to represent the rate of flow in the pipe the conductance S should be numerically equal to the square root of the relative height of the mercury column in the U-tube of the meter divided by the fixed resistance of the meter circuit. From the same equation

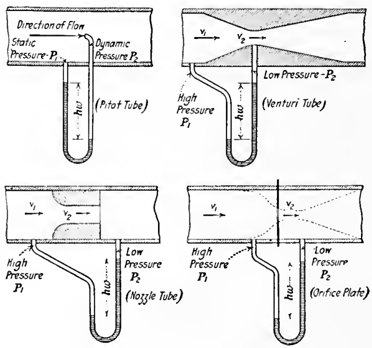

Figure 2.

$$h = S^2R_1^2\,h_m \ldots\ldots\ldots \textbf{[11]}$$

That is, the height of the mercury column for a given flow in the pipe is proportional to the square

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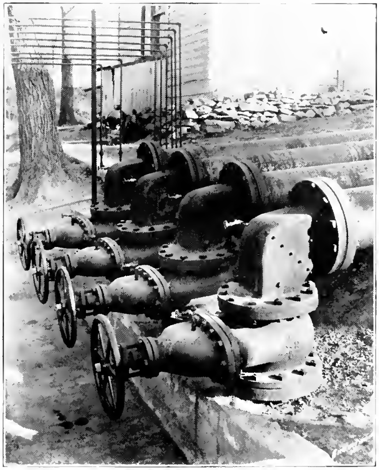
MEASUREMENT OF FLOW

PART 3

By JULIUS M. NAIMAN, '21,
President, The Hyperbo Electric Flow Meters Co.

IN A previous article the author has discussed the methods which have been so far used for the measurement of flow. It will be recollected that the Pitot tube, orifice, and Venturi tubes were analyzed with reference to their reliability as sources of pressure difference for flow metering. The author has brought out the acknowledged fact that the turbulent, swirling flow commonly found in commercial piping makes it difficult, nay impossible, to know the exact nature of the flow to be metered. For this reason local calibration is necessary to determine the flow coefficient if the above mentioned sources of pressure difference are to be relied upon for flow metering. Many tests have also proved that when these flow coefficients are thus determined, they vary to the extent of four or five per cent for flows ranging between twenty-five and one hundred per cent of meter rating.



Hyperbo flow meters installed at the plant of the Kansas City Gas Co.

To overcome these objections, the hyperbolic elbow has been invented by the author, as a source of pressure difference. To fully appreciate the value of and logical reasons for this new flow metering device, let us place ourselves in the "inventor's shoes", and imagine ourselves facing the difficult problem of finding a source of pressure difference which would not require local calibration, but which would furnish us a flow coefficient entirely independent of local piping conditions and remaining constant for all ordinary flow ranges.

The first idea that would naturally occur to us would be the point that the main cause of all our troubles is the fact that the flow is complicated, turbulent, swirling, and about as definite in nature as a sand storm. How much more should we have been pleased if the nature of the flow were plane and stream line! And right here we get an idea. Can we not make the flow as simple as that, when we do not find it so in the first place? Can't we break up the turbulent flow and change it into a plane stream line flow?

And with this to start with, we win half the battle by conceiving the idea that, before any metering is to be attempted by us, we are to break up the original complicated flow into a plane stream line flow, and then only are we to meter the flow. Our next problem then is: How are we to make this desirable change in a practical and efficient manner?

To break up the flow from an up and down motion into a plane flow we can resort to a number of plane parallel, thin, rust-proof sheets, such as monel metal plates or grids, by placing them in such a way that they face the flow. This would cause the turbulent flow to be broken up, and would force the fluid to move between the planes of the monel "grids." It would be necessary to fasten these "grid plates" in the pipe in such a manner that they would always remain in the same known position.

But after the flow is thus made a plane motion it may still consist of numerous eddy currents in each plane. To eliminate these eddies, we can resort to the powerful weapon, centrifugal force, and if the latter is properly handled, the eddy currents have very little chance of surviving. We can secure the centrifugal force by causing the fluid to flow around a curve, such as a 90 degree elbow.

All this is simple enough. But how are we to design the curvature of the elbow so that centrifugal force will help our cause rather than hinder it? A little thought will make us realize that in order for stream line flow to maintain itself, while the fluid flows through the elbow, there must be an *exact equilibrium between pressure, velocity, and centrifugal force*. For, if we follow the flow of a given particle of fluid from one point of a given stream line to another point of the latter, which, let us say, is located where the change of curvature is greatest (usually in the plane cutting the 90 degree elbow into two symmetrical halves), the pressure of this particle of fluid will increase in order to balance the centrifugal force, which, according to the law of conservation of energy, reacts against the change in direction of flow of

the fluid particle. This *increase* in pressure will result in a *decreased* velocity at the point under consideration. On the other hand, centrifugal force changes as the square of the velocity, namely,

$$\text{Centrifugal force} = F = \frac{Dv^2}{gR} \ldots\ldots [1]$$

where,

F = centrifugal force, in pounds
D = density of the fluid, in pounds per cubic foot
v = velocity of the fluid particle, in feet per second
g = 32.2 feet per second
R = radius of curvature, in feet, of the stream line at the point considered.

Therefore, the above mentioned decrease in velocity will cause a still greater decrease in centrifugal force.

But what balances the centrifugal force and makes it possible for the particle of fluid to go around the curve is additional pressure, superimposed by the curved wall of the elbow upon the original static pressure of the gas. This balance is expressed by the relation,

$$\frac{dP_d}{dR} = -\frac{Dv^2}{gR} \ldots\ldots\ldots\ldots [2]$$

where $\frac{dP_d}{dR}$ represents the rate at which the pressure difference, P_d, changes per unit length of the radius of curvature R; and v is the velocity at the point under consideration. The pressure difference must therefore vary with different radii of curvature to balance any change in centrifugal force. If the latter decreases, as we have assumed above, the pressure must also decrease. This means that the originally assumed increase in pressure must now be modified, that is decreased, to adjust itself to the change in velocity and centrifugal force. But, when pressure thus assumes a new lower value, the velocity will increase and so will the centrifugal force. This increase of centrifugal force means a corresponding increase in pressure, which will modify the previous lowering of pressure. But this again means less velocity, less final pressure, and so on, until the three correlated factors of pressure, velocity, and centrifugal force, are of such values that both the law of conservation of energy and the law of centrifugal force are satisfied.

When we have such a complete balance at every point of each stream line, the stream line flow will maintain itself. If the curvature of the elbow were such that balance could not be maintained, stream line flow could not exist and we would have swirling motion instead.

Strange to say, a circular elbow will not satisfy the conditions of equilibrium required for stream line flow. A physical picture of one important point in which the circular elbow fails can be obtained as follows:

As we pointed out before, there is a building up of pressure as the fluid approaches the 45 degree plane of the 90 degree elbow, i. e., where the latter is cut into two symmetrical halves. This is necessary for counteracting the centrifugal force, which tends to prevent the fluid from flowing around the curve. Now, when pressure builds up, velocity must decrease in the 45 degree plane. Since the same volume of fluid must pass through this plane as through the entrance to the elbow, the 45 degree plane must have a larger cross-sectional area than that at the entrance. But a circular elbow has the same cross-sectional area at the entrance and at the 45 degree plane. Therefore, such an elbow can not accommodate the adjustments in velocity, etc., necessary for maintaining stream line flow. For this reason a swirling motion is usually found in circular elbows, with resulting higher pressure drops due to increased friction as compared with straight runs of pipe.

We are thus confronted with the problem, what curvature of the elbow will maintain a stream line flow?

It is shown in Lamb's "Hydrodynamics" that, in order that plane stream line frictionless flow may be maintained the nature of the curvature path must fall within a certain class of curves whose general equation in polar co-ordinates is of the form:

$r^n \sin(n\Theta)$ = a constant .... [3]
For $n = 1$, the equation of the curve becomes $r \sin \Theta$ = a constant, or y=constant. [3a]
For $n = 2$, the equation becomes
$r^2 \sin 2\Theta$ = a constant, or........... [3b]
$2r \cos \Theta\, r \sin \Theta$ = a constant, or
$2\,xy$ = a constant.

The first equation shows one curve to be a straight line. The second equation shows another curve to be a *rectangular hyperbola.* Evidently no other curve of the second degree, e. g., a circle, will satisfy the general condition given by equation (3). In other words, *a circular elbow will not maintain a plane circular stream line flow*, while *a rectangular hyperbolic elbow will maintain a plane hyperbolic stream line flow.* It is for this reason that the hyperbolic elbow instead of the circular elbow was chosen as a source of pressure difference by the Hyperbo-Electric Flow Meter Company. Since this company is in control of Arvid Levin's circular elbow patent, described in Proc. A.S.M.E., April, 1914, the choice of the hyperbolic elbow was made for purely scientific reasons.

The stream line of a fluid flowing through a hyperbolic elbow are therefore a family of hyperbolas whose general equation is

$$xy = \frac{R^2}{2} \ldots\ldots\ldots\ldots\ldots [4]$$

where R is the shortest radius vector of any hyperbola. Thus in a 12 inch hyperbolic elbow, used in a 12 inch pipe line, the outer curve is a rectangular hyperbola whose shortest radius vector is 4 inches. Its equation is therefore,

$$xy = \frac{(4)^2}{2} = 8 \ldots\ldots\ldots\ldots [4a]$$

The inner curve for the same 12 inch hyperbolic elbow is a rectangular hyperbola whose shortest

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THE UPKEEP AND REPAIR OF STORAGE BATTERIES*

By Paul R. Unger, '24

Why do two men using like batteries under similar conditions get opposite results in both capacity and life? This is largely a question of attention and repair. One takes care of his battery, gives it pure water regularly, and takes it to a reliable service station for frequent inspection. His battery gives him good service and long life. The other

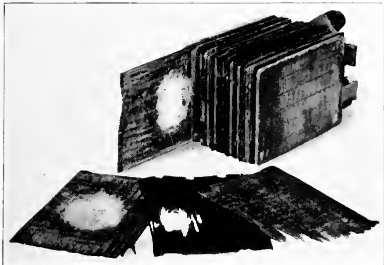

Figure 1.

man puts the battery in the car and then promptly forgets that he has one as long as the starter works. When, some fine day, he presses his foot on the starter and doesn't hear his motor hum he begins to wonder what is wrong. Finding plenty of gas and being unable to locate the trouble, he finally calls in an expert to look over his car. Usually this inspection is merely a post mortem inquest and he is in the market for a new battery.

Under ordinary usage, a battery does not wear out suddenly. The deterioration of the plates is very gradual. Early in the life of the battery, the plates begin to shed their active material which falls in minute dust-like particles to the bottom of the cell forming a sediment or "mud" as it is commonly called. The capacity of the battery does not decrease with this shedding as long as the frame of the plates remains whole. In fact, as the grids become thin from wear, the cell is at its height of liveliness due to the relative amount of surface exposed and to the depth with which the reaction goes into the plates.

The harder or more closely packed the active material is, the slower will be the shedding, and the longer the life of the cell. But with this hardness comes decreased porosity which lessens the rate of diffusion, thus lowering the capacity. Hydrogen and oxygen gas are evolved in the battery reaction and they must escape through the pores of the plate. If these pores are clogged up, the battery will not function efficiently.

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As the quantity of mud increases it may, in time, reach the lower level of the grids which rest on ribs projecting upward from the bottom of the jar. This should be avoided wherever possible as it may produce a short circuit which will lower the capacity of the cell. Whenever possible, the mud should be removed before it becomes really dangerous.

Short circuits are serious wherever they occur in any electrical system. There are two kinds:

(1) Direct short circuits resulting from the contact of two chafed wires.

(2) Indirect short circuits which are caused by "grounds" or the contact of one chafed wire with some metallic conductor, over which it passes.

In battery practice the short circuit is inside the cell and is brought about often by the contact of two adjacent plates. This is generally due to faulty insulation or worn out separators, buckled plates that break through the mats, accumulation of mud, or impurities in the electrolyte. This internal discharge is usually evidenced by a considerable heating while being changed, and a gradual decrease in capacity.

REPAIR OF BATTERIES

When a battery comes in for inspection, its exterior should be thoroughly inspected before it is dismantled. Very frequently the disorder can be found and repaired without opening the cell. The battery should be first thoroughly cleaned, especially around the tops of the cells and the terminals and connectors. A rag

Figure 2.

dipped in sodium bicarbonate will both clean the parts and neutralize any acid that may have collected on top.

Next inspect for loose or broken terminal and connectors. Poor contact will usually be accompanied by low voltage and heated connectors should be renewed if necessary.

Be sure that the covers are not leaky and are properly sealed. The usual indication of defective sealing is corroded terminals and acid soaked cell covers.

Remove the vent caps and see that the acid level is maintained above the tops of the plates. This is very essential. Exposure of the plates is a potent factor in causing sulphation, lowering the capacity of the battery and overheating the plates. The lower the acid level is, the more concentrated is the electrolyte. If the acid becomes too strong, it will attack the lead plates and may prove fatal to the battery. Besides the resistance of concentrated sulphuric acid is such that it is not a good conductor. Acid should never be added to a cell unless it be known that some of the electrolyte has been lost through spillage, leaky containers or excessive gassing. If the acid level in one cell is much lower than that in the rest, it is usually indicative of a leaky jar.

The history of the battery or any other reports obtainable should be consulted freely. Knowledge of the battery's previous troubles and action is often a material aid in prescribing the proper treatment.

If after this thorough external inspection the disorder is not yet located the unit should be dismantled.

The terminals and connectors are removed by one of two methods.

(1) Drilling the connectors loose from the terminal posts. A ratchet brace and a twist drill are used, the drill being about one thirty-secondth (1/32) of an inch larger than the diameter of the terminal post. The drill point should be accurately centered on the terminal. The hole should be drilled to a depth just larger than the thickness of the connector. Then the connector may be lifted off with a pair of pliers.

(2) Very often instead of using the drill, the plates are burned off. The small hot cone of an air-acetylene or hydrogen blow pipe is directed vertically downward on the terminal post. The connector is gripped with a pair of pliers and lifted off when the terminal is sufficiently hot to allow its removal.

The cell is unsealed by scooping up the sealing compound with a hot putty knife. It is essential that all of the sealing compound be removed. Often it is convenient to preheat the surface of the compound with a blow torch.

The cover is now removed, and the element lifted vertically out of the jar being careful to allow most of the acid to drain from the plates. The element is placed on a clean table for inspection. It is a good plan to put a few white blotters under the plates lest the acid injure the table. First remove the separators by gripping them with a pair of pliers after the plates have been spread slightly. If the separators are defective (see Figure 1) they should be replaced. In fact, it is usually more satisfactory to install new separators anyway. When rubber separators are used they are usually found satisfactory and after a thorough washing are ready to be reinstalled.

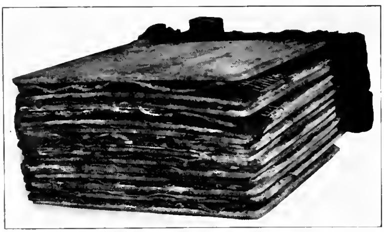

Figure 3.

Figure 4.

The positive and negative groups are separated and the plates inspected. When in good condition the positive plate is a dark chocolate brown in a fully charged condition and a reddish brown when discharged. The negative plates are battleship grey charged, and a lighter grey when discharged. This does not mean that all plates not conforming to these colors should be discarded. On the contrary, the disorder can be very often found and remedied.

In general the plates should be cut off and discarded when in the following conditions:

(1) The plates have cracked or broken grid skeletons.

(2) The active material has shedded to such a degree that the skeleton of the grid is exposed. (See Figure 2.)

(3) The plates are buckled beyond repair. (See Figure 3.) Buckled plates are sometimes caused by poor casting in the manufacture of the battery. The lead-antimony does not always form a homogeneous alloy on cooling. More frequently buckling is caused by habitually discharging the battery below the voltage limit. Charging at too high a rate will cause

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of the conductance of the meter circuit. From equation **[10]**

$$R = \frac{1}{S} = R_1 \sqrt{\frac{h}{h_m}} \text{.........} \textbf{[12]}$$

That is, the resistance R, $(=R_1+R_2)$, should be inversely proportional to the square root of the relative height of the differential column.

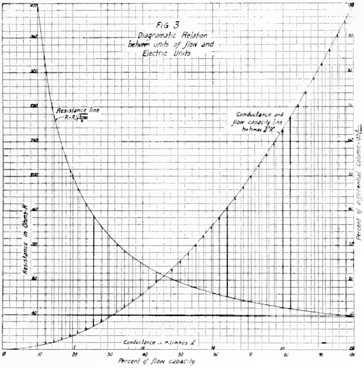

Figure 3.

Figure 3 shows diagrammatically the relation of the units involved in the electric measurement of the flow. The parabolic curve to the right shows the variation of the conductance in the electric circuit representing the capacity of the flow in the pipe, and corresponding to the percentage variation in the differential column balancing the velocity pressure of the flow. This curve represents the solution of Equation **[11]**. The hyperbolic curve to the left of the diagram shows the relation between the conductance (or flow capacity) and the corresponding resistance of the electric circuit. The solution of Equation **[12]**, or the relation of R to h, is obtained indirectly by following from a given value of R on the resistance curve to the corresponding value of h on the conductance and capacity curve.

It will be observed that the diagram does not include the first 10 per cent of the flow capacity inasmuch as this represents only 1 per cent of the differential column, which is as low as a practical device is able to measure with any degree of accuracy. This disadvantage, however, is offset by the fact that the scale of the flow meter can be chosen so that the desired measurements will fall within the active part of the scale.

In order to get the summation of the rate of flow, it is apparent from equation **[6]** that there must be an integration of the conductance, S, with respect to time, or

$$\int S dt = \frac{1}{V} \int G dt = \frac{M}{V} \text{........................} \textbf{[13]}$$

The electrical instrument by which $\int S dt$ is obtained is an alternating current, induction-type, integrating meter, resembling in some respects the induction type watt-hour meter, but differing from it in important particulars.

The elementary principles of this instrument may be explained in connection with the diagrammatic drawing of Figure 4. The disc D of conducting material is free to rotate about a perpendicular axis through its center in the air gaps of two electromagnets having the windings W_1 and W_2 respectively. W_1 is highly reactive and is connected directly to the secondary of the transformer E. W_2 has a low reactance and is connected in series with the resistances R_1 and R_2, this circuit being practically non-inductive. The resistances R_1 and R_2 have the same meaning as in Figure 1.

The currents in the windings W_1 and W_2 produce the corresponding fluxes ϕ_1 and ϕ_2 and these fluxes react upon currents induced in the disc to create a torque. This torque is expressed with sufficient accuracy by the equation applying to all induction type instruments, namely,

$$T_a = K \phi_1 \phi_2 f \sin \alpha \text{.....................} \textbf{[14]}$$

in which

T_a = accelerating torque
K = a constant
f = frequency
α = phase angle between ϕ_1 and ϕ_2

As the disc rotates under the action of this accelerating torque, it cuts across the fluxes ϕ_1 and ϕ_2 and thereby develops a retarding or damping torque. By construction, ϕ_2 at its greatest value has a magnitude of only a few per cent of ϕ_1 so that practically all of the retarding torque is due to the motion through ϕ_1. It is therefore very closely expressed by the equation

$$T_r = K' \omega \phi^2$$

in which

T_r = retarding torque
K' = a constant
ω = angular velocity.

Neglecting friction, which is very slight, the speed of the disc will acquire such a value that

$$T_a = T_r \text{................} \textbf{[15]}$$

hence

$$K' \omega \phi^2 = K \phi_1 \phi_2 \; f \sin \alpha \text{.........} \textbf{[16]}$$

$$\omega = \frac{K}{K'} \frac{\phi_1}{\phi_2} f \sin \alpha \text{............} \textbf{[17]}$$

So long as the reactance of the circuit through W_1 is large compared to its resistance

$$\phi_1 \propto \frac{V}{f} \text{ (approximately).......} \textbf{[18]}$$

and

$$\phi_2 \propto VS \text{......................} \textbf{[19]}$$

where

S = conductance of the curcuit through W_2, R_1 and R_2, and
V = voltage applied from transformer E.

Substituting from **[18]** and **[19]** for ϕ_1 and ϕ_2 in **[17]** gives

$$\omega = K_1 \, G \, f^2 \sin \alpha \text{..........} \textbf{[20]}$$

in which K_1 a constant. And if the frequency remains fixed, α is constant, and Equation **[20]** becomes

$$\omega = K_2 \, S \text{..............} \textbf{[21]}$$

in which K_2 = a constant.

Multiplying both sides of Equation **[21]** by dt and integrating gives

$$N = K_4 \int S\,dt \ldots\ldots\ldots\ldots \textbf{[22]}$$

in which N = number of revolutions of disc

K_4 = a constant.

It is thus seen that the number of revolutions of the disc as indicated on dials by a train of gears is the integration of a conductance with respect to time, which, by construction, is a measure of the total quantity of the fluid passed through the pipe, as shown by equation **[13]**.

It is apparent from the development of Equation **[22]** that the integration by the meter is independent of the voltage from which the meter operates. It is to be understood, of course, that this independence will not exist for extreme variations of voltage. For example, the instrument will obviously not operate with zero voltage; and if the voltage is so high as to produce saturation in the electromagnets, the indications will be the same as they are for unsaturated magnets. In designing this meter, a voltage regulation of plus or minus 10 per cent was used as the basis, and for this range the instrument is practically independent of the voltage.

Referring to Equation **[20]** it is seen that a change in the frequency would change the indication of the meter, and, since the frequency may vary a few per cent from normal, it is desirable to have the instrument practically free from error due to such a

FREEMAN INTEGRATOR DIAGRAM

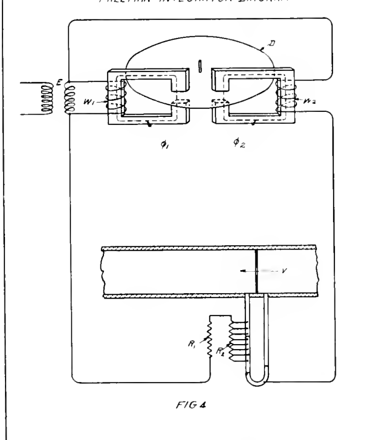

FIG 4

11 21-22 CHP RFM Co DWG#D-468

cause. This has been accomplished by an arrangement of circuits shown in Figure 5. No other mechanical parts are indicated in this figure, but the letters common to Figure 4 and Figure 5 refer to the same electrical features. The resistance R_1 is shunted by a resistance R' and a reactance X, the reactance being several times the resistance R_1 or R^1. The winding W_2 is now made of a large number of turns and is highly reactive. It is connected in parallel with R^1 and its reactance is several times

FREEMAN INTEGRATOR DIAGRAM.

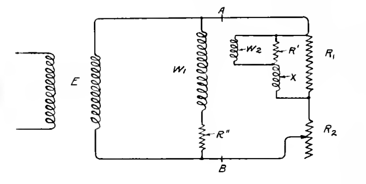

FIG. 5

11-21-22 CHP R.F.M. Co. DWG. #D-469

greater than the resistance R^1. We may then write that,

$$\phi_2 \propto \frac{V^1}{f} \quad \text{(approximately)} \ldots\ldots \textbf{[23]}$$

in which V^1 = voltage drop over R^1.

But $$V^1 \propto \frac{V_1}{f} \quad \text{(approximately)} \ldots\ldots \textbf{[24]}$$

Where V_1 = drop over R_1

and $$V_1 \propto VY \quad \text{(approximately)} \ldots\ldots \textbf{[25]}$$

in which Y = admittance of the circuit from A through R_2 to B, and V = applied voltage.

But $$S = Y \quad \text{(approximately)} \ldots\ldots \textbf{[26]}$$

since the shunted reactances are large compared with the resistance and therefore the susceptance is practically negligible. Combining these relations we get

$$\phi_2 \propto \frac{VG}{f^2} \quad \text{(approximately)} \ldots\ldots \textbf{[27]}$$

Recalling that

$$\phi_1 \propto \frac{V}{f} \quad \text{(approximately)} \ldots\ldots \textbf{[18]}$$

and substituting these relations in Equation **[17]** we get $\omega = K_5 S \sin \alpha$ (approximately)... **[28]**

in which K_5 = a constant.

By making α about 90 degrees, sin α changes very little with change in frequency. This value of α is obtained by introducing a resistance R'' in series with W_1.

While there are several factors entering into the frequency effect, it has been found possible to design the meter so that the frequency error is practically negligible for the ordinary fluctuations found in light and power circuits. Equation **[28]** may then be put in the form

$$\omega = K_6 S \ldots\ldots\ldots\ldots\ldots\ldots \textbf{[29]}$$

$$N = K_7 \int S\,dt = K_7 \frac{M}{U} \ldots\ldots \textbf{[30]}$$

It was shown in equations **[3]** and **[4]** that the volume and the weight of the fluid measured depend upon the density as well as the velocity through the pipe. With gases, the density may change appreciably and it may be desired to make corrections for such changes. The density is a

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radius vector is 14.5 inches. Its equation is therefore,

$$xy = \frac{(14.5)^2}{2} = 105 \ldots\ldots\ldots \textbf{[4b]}$$

The intermediate stream line are hyperbolas whose shortest radii vectors lie between 4 inches and 14.5 inches.

Since all these hyperbolas are approaching the same co-ordinates as asymptotes, the innermost and outermost hyperbolas must get closer and closer to each other as they approach the entrance to the elbow. They are furthest apart along the 45 degree line, which may justly be called the line of symmetry, and which is also the line of the shortest radii vectors. Therefore in the case of the hyperbolic elbow, the cross-sectional area at this plane of symmetry is greater than that at the entrance to the elbow, and will not for this reason interfere with adjustments in velocity, etc., necessary for maintaining a stream line flow.

Since for a plane stream line flow a definite balanced relation exists between velocity, pressure and centrifgual force at every point of any stream line, the same must be true for any point in the 45 degree plane of the hyperbolic elbow. For simplification and more perfect balance, this elbow is made of uniform depth so that any cross section is a rectangle. It is the average velocity through this rectangular area which is ordinarily measured. This is done by measuring the pressure difference between two points on the line of symmetry, one point near the inner hyperbolic curve and the other near the outer curve. Because of the existing definite motion, the pressure difference between these two points has a definite relation to the average velocity through the plane of symmetry, that is, a definite flow coefficient exists. When this average velocity is multiplied by the area of the rectangular section, the rate of flow is determined. Thus we have,

$$v_a = K\sqrt{2gH} = K\sqrt{2g\frac{P_d}{D}} \ldots\ldots \textbf{[5]}$$

$$Q = Av_a \ldots\ldots \textbf{[6]}$$

$$W = DAv_a = AK\sqrt{2gP_dD} \ldots\ldots \textbf{[7]}$$

where, v_a = average velocity through the plane of symmetry of the elbow

K = flow coefficient of the elbow

H = equivalent velocity head corresponding to the average velocity.

P_d = pressure difference corresponding to the velocity head H

D = density of the fluid

A = area of plane of symmetry rectangle

Q = flow of the fluid, in cubic feet per second

W = flow of the fluid, in pounds per second.

Having thus solved the problem of proper curvature of the elbow for maintaining a definite stream line flow, resulting in a definite relation between average velocity and a measurable pressure difference, our next problem is to determine this definite relation, or flow coefficient .

As was previously pointed out, the balance between centrifugal force and pressure distribution along the line of symmetry gives us one connecting link between velocity and pressure. That is

$$\frac{dP_d}{dR} = \frac{Dv^2}{gR} \qquad \textbf{(Equation 2)}$$

Then again, we have the kinematical fact of a definite stream line flow, the stream lines being rectangular hyperbolas. Thus, if the velocity at any point is analyzed by its components along the X-axis and Y-axis, the relation between these components must be such that their resultant would fall tangent to the hyperbolic stream line at every point of the stream line.

It is shown in Lamb's "Hydrodynamics" that for frictionless flow along hyperbolic stream lines, the resultant velocity is at every point proportional to the length of the corresponding radius vector. This, in a rectangular hyperbola, is equal to the radius of curvature at the same point. That is,

$$v = BR \qquad \textbf{[8]}$$

where B is a constant which depends upon the rate of flow.

From the centrifugal force equation **[2]** and from the velocity equation **[8]** we now have sufficient data for calculating the flow coefficient in the case of frictionless flow. By substituting the expression for velocity found in equation **[8]** into equation **[2]** we may obtain an expression for the pressure difference. This can be shown to be

$$P_d = \frac{DB^2}{2g}\left(R_5^2 - R\right) \qquad \textbf{[9]}$$

where

R_5 = shortest radius vector of the innermost hyperbola

R = shortest radius vector of any other hyperbola

P_d = pressure difference between the innermost and any other pressure connection along the line of symmetry.

If the second pressure connection is made at the outermost hyperbola, whose shortest radius vector is R_1, the pressure difference used for flow metering is equal to

$$P_d = \frac{DB^2}{2g}\left(R_5^2 - R_1\right) \qquad \textbf{[9a]}$$

Similarly from equation **[8]** the expression for average velocity along the line of symmetry can be calculated to be

$$v_a = \frac{B\,(R_5 - R_1)}{2} \qquad \textbf{[10]}$$

And by comparison of the equations for pressure difference and average velocity their relation is found to be,

$$v_a = \frac{(R_5 - R_1)}{2}\sqrt{\frac{2gP_d}{D(R_5^2 - R_1^2)}} = \sqrt{\frac{(R_5 - R_1)^2}{4(R_5^2 - R^2)}}\sqrt{2gH} = K\sqrt{2gH} \qquad \textbf{[11]}$$

Therefore, for frictionless flow, the flow coefficient of a hyperbolic elbow is,

$$K = \sqrt{\frac{(R_5 - R_1)^2}{4(R_5^2 - R_1^2)}} = \sqrt{\frac{R_5 + R_1}{4(R_5 - R_1)}} \qquad \textbf{[12]}$$

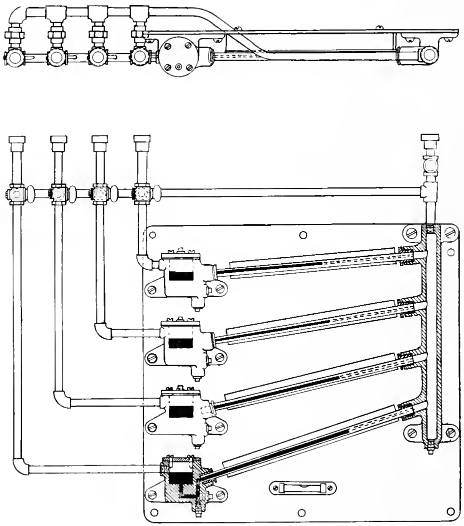
The simplicity of calculating the frictionless flow coefficient of a hyperbolic elbow is thus apparent. It is worthy of mention at this point that, in the case of water, actual weighing tests made at the Armour Institute of Technology have shown the flow coefficient for water to be very close to that corresponding to frictionless flow. The reader is referred to the author's graduation thesis for further details of these tests. It is to be noted that, for frictionless flow, the pressure distribution along the line of symmetry follows the law of a parabola of the second degree.

Ordinarily, however, friction is found to be a factor, e. g., in the case of steam, gases, etc. It is here that the perfect balance between pressure, velocity, and centrifugal force necessary for maintaining a stream line flow, comes in particularly handy. For, suppose that for any reason whatever, the velocity distribution along the line of symmetry should change; say, because of friction, or taking an extreme case, because foreign material is purposely fed into the elbow. This change of velocity distribution, whether large or small, would immediately change the centrifugal forces, with a corresponding readjustment of pressure distribution in accordance with the centrifugal force equation. Therefore, if we experimentally measured the ultimate new pressure distribution and in this way determined the equation of the pressure distribution curve, we could still make use of equation (2) for calculating the law of velocity distribution. In other words, a pressure distribution curve for the line of symmetry of a hyperbolic elbow is a veritable X-Ray picture of the exact nature of velocity distribution along that line. After we know the law of velocity distribution, it is a simple matter to calculate the average velocity in terms of pressure difference, and from the last information, the flow coefficient of the hyperbolic elbow.

The factor which will thus finally determine the constancy of the relation between average velocity and pressure difference, or the constancy of the flow coefficient, is constancy in the nature of the pressure distribution curves. For in order that the flow coefficient at low velocities should be, let us say, of a greater value than at higher velocities, the nature or equation of the pressure distribution curve must change with different loads. Only such a change would indicate a change in velocity distribution with a corresponding change in the relation between average velocity and pressure difference, resulting in a change in the flow coefficient.

Now pressure distribution along the line of symmetry of a hyperbolic elbow lends itself easily to direct measurement. Thus by the use of a multimanometer which consists of four manometers with a common pressure connection on one side, it is possible to measure along the line of symmetry, the pressure difference between the pressure connection at the inner curve and that at any of the other points along the same line of symmetry.

Four pressure differences are thus measured, all at the same time, the maximum obtainable pressure difference being between the inner curve pressure connection and that at the outer curve of the elbow. From these simultaneous four pressure difference readings, a pressure distribution curve may be plotted in terms of pressure difference against radii vectors, the latter being the distances of the pressure connection points from the origin of the hyperbolic curves of the elbow. By varying the flow, the maximum pressure difference may be changed with corresponding changes in the other three pressure differences, supplying data for a new pressure distribution curve. For this test it is not necessary



The Multimanometer

to know the exact rate of flow, nor any characteristic of the fluid such as static pressure, temperature or specific gravity. The whole test consists of taking simultaneous pressure difference readings with the multimanometer. The simplicity of such a test is thus apparent.

This is just what was done in the case of the Kansas City Gas Company at their 25th street station upon a 12 inch line. Gas flow was varied from about 100,000 cubic feet per hour to 400,000 cubic feet per hour with a large number of intermediate rates of flow. To compare the pressure distribution curves for all these rates of flow, theoretical curves were plotted following a definite higher parabolic law, namely

$$P_d = C_o - CR^{2\frac{1}{2}} \qquad \textbf{[13]}$$

where P_d = pressure difference, inches of water

C_0 and C are constants.
R = radii vectors, inches.

The $2\frac{1}{2}$ degree parabola was chosen after an analysis of the experimental data. On the same sheet the actual pressure difference readings were plotted, those of each test corresponding to the same rate of flow being marked by the same symbols. The alignment of these points with the theoretical curves was then studied to determine how closely the theoretical curves agreed with the experimental data.

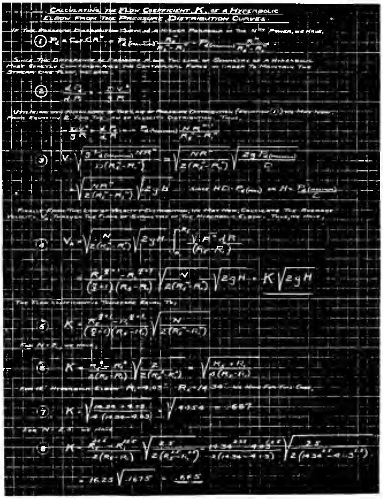
The reader's attention is referred to the curves shown in Figure 2, which were secured from pressure distribution tests on natural gas. A close agreement between experimental data and the curves will be noted. This agreement exists in spite of a variation in the tests of from 24 per cent to 100 per cent of maximum load conditions. When the fact is considered that pressure distribution is so sensitive to any change in the nature of flow that a change in the flow coefficient of only 0.3 per cent affects the power of the parabolic curves as much as 25 per cent, it becomes apparent that the small differences between some of the observed pressure readings and the corresponding calculated values, as indicated by the curves, have very little effect upon the final value of the flow coefficient. Thus, for frictionless flow, when the theoretical pressure distribution curves are parabolas of the second power, the calculated flow coefficient for the hyperbolic elbow is

$$K = 0.667$$

while for the actual flow, where friction is a factor, and in which case the pressure distribution curves were experimentally found to be parabolas of the $2\frac{1}{2}$ power, the same coefficient comes out to be

$$K = 0.665.$$

With these consistent pressure curves in mind, with their sensitiveness to changes in the nature of flow, and with their definite known relation to velocity distribution, do we not have ample proof of the fact that a hyperbolic elbow has a constant



Derivation of flow coefficient for Frictional Flow

flow coefficient for all gas loads commonly encountered. We must remember that 400,000 cubic feet

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FIGURE 1

HOLDER TEST, JULY 25, 1922—29th AND INDIANA
KANSAS CITY GAS CO., KANSAS CITY, MISSOURI

Time	10 P.M.	11 P.M.	12 P.M.	1 A.M.	2 A.M.	3 A.M.	4 A.M.	5 A.M.
Position of Holder — Street	0	2	3	5	6	7	8	9
Position of Holder — Marker	6.7"	0.2"	23.7"	7.6"	16.2"	21.5"	26.9"	34.4"
Position of Holder — Water Level	65.2"	65.2"	65.2"	65.2"	65.2"	65.3"	65.3"	65.4"
Third Lift Pressure	9.8"	9.8"	9.8"	9.8"	9.8"	9.8"	9.8"	9.8"
Total Inches	68.3"	75.2"	98.7"	82.6"	91.2"	96.6"	102.0"	109.6"
Equivalent to Sheet	2	1	2	2	2	2	2	2
Capacity of Sheet	2,184,361	2,271,958	2,447,153	2,622,3[illegible]7	2,709,944	2,797,542	2885,139	2,972,736
Additional Inches	16.8	36.2	20.7	4.6	13.2	18.6	24.0	31.6
Capacity of Inches	37,734	81,308	46,494	10,332	29,648	41,777	53,906	70,976
Total in holder	2,222,095	2,353,266	2,493,647	2,632,679	2,739,592	2,839,319	2,939,045	3,043,712
Temperature Dry	77.7	77.2	76.7	76.7	76.7	76.4	76.3	76.3
Temperature Wet	76.0	75.7	75.1	74.4	74.1	73.7	73.2	72.9
Dew Point Depress	1.7	1.5	1.6	2.3	2.6	2.7	3.1	3.4
Vapor Pressure	.948	.934	.918	.918	.918	.910	.907	.907
Relative Humidity	.928	.937	.932	.902	.890	.855	.867	.855
Corrected V. P.	.879	.875	.855	.828	.817	.805	.786	.775
Baro. Reading	29.12	29.11	29.08	29.08	29.08	29.08	29.08	29.08
Holder Press.	.722	.722	.722	.722	.722	.722	.722	.722
Absolute P-V. P.	28.963	28.957	28.957	28.974	28.985	28.997	29.016	29.027
Factor-50°-8 oz.	.031297	.031326	.031355	.031355	.031355	.031373	.031379	.031370
Coefficient	.90645	.90711	.90794	.90848	.90882	.90972	.91049	.91084
Cor. Gas in Holder	2,014,218	2,134,671	2,264,082	2,391,736	2,489,796	2,582,985	2,675,971	2,772,334
Hourly Additions		120,453	129,411	127,654	98,060	93,189	92,986	96,363
Meter Additions		122,200	127,300	127,300	95,500	93,900	93,900	96,000
Discrepancies		+1,747	—2,111	— 354	—2,560	+ 711	+ 914	— 363
0/0		+ 1.4	— 1.6	— 0.2	— 2.6	+ 0.7	+ 1.0	— 0.4

Total Additions Holder 758,116 C.F.
Meter 756,100 C.F.
Discrepancy 2,016 C.F.
Slow 0.26 0/0

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a considerable overheat in the cell which will expand the plates until, being restrained on all edges, they can do nothing but buckle.

Plates in which buckling is not too serious may be straightened out by removing them from the element and pressing them between two clean boards in a plate press or an ordinary bench vise.

(4) The plates are sulphated to such a degree that restoration is impossible as shown in Figure 4. Sulphations produce a white chalk-like substance over the surface of the active material of the plates. Being a nonconductor of electricity this substance lowers the battery capacity to a very marked degree.

Exposure to the air will cause rapid sulphation of the plates. In particular, the negatives will be sulphated injuriously. Charging will usually remove the sulphate from the positives while to remove it from the negatives requires considerable overcharge which, as stated above, is dangerous from the point of buckling. So it is sometimes necessary to injure one part of the battery to cure another. Lacking this overcharge the sulphation will continue until the entire plate is ruined.

To restore a badly sulphated negative to use, a special cycle of charge and discharge is used instead of one overcharge. These cycles are called treating cycles. The cells are charged for a long time at a rate low enough to produce a maximum gravity reading with the least gassing and rise in temperature. The cells are then discharged at a ten hour rate to a final voltage of about 180 volts and then recharged. This cycle is continued until the particles of active materials have readjusted themselves and the plate has assumed its normal condition.

Sulphation may usually be detected from:

(a) High cell voltage during charge.
(b) Low cell voltage during discharge.
(c) Drop in specific gravity of electrolyte.
(d) Color of plates. Positive plates become a reddish brown and negative plates a whitish gray. Both contain white spots of sulphate.

Idleness is a frequent cause of sulphation. The plates of batteries left in a discharged condition tend strongly toward sulphation. Batteries in storage or otherwise idle should be charged at least once a month.

The electrolyte surface should at all times be kept above the tops of the plates, that no part may be exposed.

(5) The active material has swelled, losing contact with the plates. Sometimes due to excessive heating, the active materials of the negatives bulges to such an extent as to lower its conductivity through poor contact with the plates. These grids can usually be put in satisfactory condition by pressing the material back in position while still soft and moist. The plates should first be washed by dipping them in clean water. Do not allow swiftly running water to come in contact with the plates as the expanded material is in a very delicate condition and can be easily washed away. The plates should then be pressed between two clean boards until the material adheres to the plates.

(6) The active material of the positive plate is very soft and muddy. If the plate was not removed when in this condition excessive shedding would soon make it useless.

(7) Local action has caused the plates to become congested with metallic or other impure deposits. This local action is very deleterious to the cell, being nothing less than a short circuit set up on the plate surface.

The defective plates may be conveniently removed by either sawing or cutting the plate on the lug just below the cross bar. A pair of nippers or a putty knife and a mallet are often convenient.

After cutting out any defective plates, new plates should be burned on and the cell reassembled. (Operations discussed by the author in "Automotive Electrical Engineer," for October, 1922.)

It is often desirable to burn a used plate back into the group after treatment. It is necessary first to lengthen the lugs which were shortened in cutting off the plates. The plate is placed on a flat surface and the lug is built around with small iron bars. Stick lead is melted over the mold thus formed until the new lug is completed.

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If the right contractor is selected, a maximum of work can be done by the contractor's own forces rather than by sub-contractors. This eliminates one profit (the sub-contractor's) on all items that can be properly handled without the introduction of a sub-contractor. These profits will average from 10 to 25% in most of the sub-contract trades involved in the usual building or industrial plant.

Construction machinery can be regulated both as to quantity and quality to reduce manual labor to a proper minimum and the charges for the contractor's machinery are open to the owner's inspection, so he can be sure he is not paying excessively for its use. The contractor's overhead or supervisory staff on the job is subject to the owner's constant scrutiny and he can insure this staff being held at a minimum. All books of account and records of every description pertaining to the work are open to the owner's audit and he can satisfy himself that there are no concealed profits. All cash discounts, which amount to a considerable total, are made to revert to the owner. A small expenditure by the owner for inspection of the contractor's work will insure energetic job administration. Changes due to errors or omissions in plans and to the owner's desire to make alterations as the work proceeds carry no penalties or unfair profits, as they are made at their actual cost plus only the additional compensation arranged for in the original contract.

This is a very wide field for discussion and there are great differences of opinion concerning the points here discussed. Familiarity with these questions should not be limited to the engineer who enters the construction field either as a construction engineer, designing engineer or contractor. They are of equal interest to those engineers who will become identified with a wide range of industries whose activities will include extension of plant facilities. Greater injustice is done to his employer by the engineer who holds prejudiced ideas antagonistic to a proper form of fee contract as applied to a large proportion of the industrial construction being done and to be done in this country. The form of contract should be such that the interests of the owner and the contractor are identical, and the contractor should have definite assurance before he proceeds that he is going to receive adequate compensation for the service he renders.

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ASSOCIATE PROFESSOR JAMES C. PEEBLES, *Editor*

To one who goes about more or less among the Armour Alumni, meets them when they drop in at the Institute, mingles with them at our semi-monthly luncheons and semi-annual banquets, one fact seems to stand out with increasing clearness. That is that our graduates after they have advanced a certain distance in the practice of the engineering profession, in very many instances, change over from purely technical engineering work into business activities. Frequently they go into some line of manufacturing where engineering training and experience can contribute very greatly toward success. Others are becoming business executives in which positions they often find that the methods of the engineer can be employed to advantage.

In almost any line of manufacturing there is need for the technically trained man in devising and putting into practice production methods. The production engineer is a relatively new figure in the industrial world, but one which will be of more importance in these days of quantity production. The automobile would never have been brought to its present state of development and sold at the present low prices if a vast amount of clever engineering work had not been done on production methods. Special tools, dies, jigs, etc., have been devised for countless operations; machines for doing these various operations have been so grouped and arranged that the product in passing through the factory covers a minimum distance with no backtracking. This makes for economy in production, and is at the same time an extremely interesting phase on engineering wherein the engineer is in contact with the business and financial end of the enterprise. Sometimes he finds that engineering considerations must give way to business for financial reasons and then he is in a fair way to become less the technical engineer and more the engineer in business.

Another field into which a number of our alumni have gone is lubrication engineering. Many times they combine their work with selling when they are known as sales engineers, a term which is rapidly coming into use in many lines of business. The work of the lubrication engineer is filled with endless variety, covering as it does the whole field of industry, wherever oil is used to lubricate machinery. One day he may be in a knitting mill where the machinery is light and the speeds high. The next may find him in a steel mill where the machinery is large, the pressure heavy and the speeds relatively low. Again, he may be working on the lubrication of an engine using steam at 600 deg. F., or the breech mechanism of an aeroplane machine gun, where the oil must remain fluid at 40 deg. F. below zero. Such are the problems of the lubrication engineer: at once a tax on the ingenuity and a stimulus to the imagination.

The above reflections relative to the broadening activities of Armour men have been prompted in a measure at least by conversations which the writer has had with several alumni during the past few weeks. C. M. Larson, '13, has been in the oil business ever since his graduation. In fact he became interested in oils and lubrication while still a student at the Institute and worked out a problem in lubrication for his thesis. Immediately after his graduation he entered the employ of the Texas Company where he developed a rather unusual ability in solving problems and overcoming difficulties in lubrication. After several years experience with this company he resigned to accept a position with the Sinclair Refining Company where he is at present supervising engineer. In this position he has supervision over a staff of engineers and salesmen, the engineering department cooperating with the sales department in the solution of any lubrication problems which may be met.

Like many of the rest of us Mr. Larson has been much interested in the scientific lubrication of the automobile because he realizes that faulty lubrication is probably the largest single factor in motor car depreciation. Particularly in the lubrication of the motor Mr. Larson has felt that some means should be available to judge with some degree of accuracy the depreciation of the oil with use. This depreciation is largely due to dilution with fuel resulting in reduced lubricating value, reduced viscosity, and higher Beaume gravity. Mr. Larson has developed and placed on the market a convenient device to test the quality of the oil through a measurement of its gravity. He has also just completed a simple viscosimeter with which in a few moments a motorist can estimate the quality of the oil in his motor through the measurement of the viscosity. The device is extremely simple and will agree with elaborate laboratory apparatus within 2% to 5%. Either or both devices if used conscientiously will save may dollars in motor repair bills.

J. M. Naiman, '21, is a recent graduate who has combined engineering and business in an interesting manner. Some time before graduation he became interested in the measurement of the flow of fluids in pipes. At that time he gave his attention chiefly to the flow of steam because he felt that the present steam flow meters are far from satisfactory. After graduation he continued his experiments and has now perfected his meter so that it will measure the flow of any commercial fluid, be it steam, air, gas, oil or water. Much of his attention has been concentrated on the measurement of the flow of gas in large pipe lines. Several of his meters have been installed in large gas mains in Kansas City where they have been giving satisfactory

results for the past six months. The meters are provided with automatic compensation for changes in temperature, pressure, and specific gravity, and are guaranteed to be accurate within 2% of the actual reading between 15% and 100% of capacity.

Mr. Naiman has incorporated his business under the name Hyperbo Electric Flow Meter Company of which he is president. He has installed an up-to-date factory equipped with modern machinery and is now engaged in quantity production of the flow meter. During a recent visit to the plant the writer was shown flow meters in various stages of production. The production of each individual part has been made a subject of special study which often involved the design and construction of special tools and equipment in order to make it economically. Factory production methods of a high order are in use in this factory and inasmuch as almost the entire technical and business staff consists of Armour men it is certain that I. A. T. has turned out some men capable of devising and putting into effect real production methods.

R. H. Strang, '04, was a caller at the Institute a few days ago. Men who were students between 1900 and 1904 will remember the "south-paw" baseball star who held down first base for the "Tech" team for three consecutive years. His sobriquet was "Fuzzy" because of an unruly shock of blond hair, which, by the way, is not as unruly now as it was twenty years ago. To those of us who knew him well, however, he seems very little changed from the days when his trusty bat drove in many a run on the baseball diamond.

Soon after leaving college Mr. Strang was appointed superintendent of the electric light and power plant in his home town, Richland Center, Wis. He was in charge of the operation of the entire property for several years where he was able to effect many economies through the introduction of modern methods. Later upon the death of his father he took over the active management of a rather extensive hardware business in which his father had been engaged for a number of years. Thus, partly from choice and partly through force of circumstances another alumnus passed from the field of pure engineering into business. When asked particularly for an expression of opinion on this point Mr. Strang replied that as he looked back on nearly twenty years in engineering and business he was fully convinced of the value of engineering training and experience as a preparation for business. He stated that he had found it true in his business and recommended an engineering course for the young man who expects to go into business, particularly in a manufacturing line.

F. P. Strauch, '16, is mechanical engineer with the Universal Oil Products Co. of Chicago. Their business deals chiefly with the production of gasoline from petroleum by means of a recracking process which they have developed. They have also developed and patented the equipment used in their process and have built a large Chicago plant for the production of gasoline. Mr. Strauch has had much to do with the engineering work in the erection of this plant and has developed into an expert in this highly specialized line of manufacture. In view of the constantly increasing demand for gasoline it is important to increase the yield to the limit and the Universal Oil Products Co., is doing a valuable work along this line.

An interesting letter has recently been received from Mr. Strauch in Baltimore where he has been since last December. His company is erecting four of their recracking plants for the Interocean Oil Co., of that city and he is in charge of the work. They are also erecting four plants for the Prudential Oil Co., just half a mile away from the other job and Mr. Strauch is supervising that installation also. In addition to the engineering work he cooperates with the purchasing departments of the two companies in the purchase of all materials and supplies needed in the work. Fred will be an extremely busy man while these eight plants are going up

The same company is building two plants at Warners, N. J., where the engineer on the job is F. J Mack, another Armour man. Strauch and Mack frequently find it necessary to communicate with each by telephone as the various problems of construction come up from day to day. Mr. Strauch is looking for an assistant and would like to get an Armour man. The business of the company is growing rapidly and any young man who starts now with Mr. Strauch will soon be in charge of erection work himself. The future of the company is very promising because the market for gasoline is almost sure to be good as far ahead as anyone can predict.

The Bready brothers, William, '15 and Ira, '20, were visitors at the Institute recently. Both are with the Permutit Company, William in Pittsburgh and Ira in Chicago.

Harold Luttge, '17, has been for several years with the Edison Power Co., Big Creek, Calif., where he has gained considerable experience in central power station work. Recently he returned to Chicago and has accepted a position with the Marshal Electric Co. who manufacture and market battery charging sets. In the present popularity of the radio it would seem that battery charging outfits should be in great demand Mr. Luttge expects to locate permanently in Chicago.

E. D. Merry, '03, is with the Hubbard Spring Company, Pontiac, Michigan. A few days prior to the recent visit of the "Tech" basketball team to Detroit he wrote asking for a copy of the new yells, so that he might be on the job as a rooter at the game with Detroit University. We congratulate Mr. Merry on his loyal Armour spirit which is still strong after being away from the Institute for 20 years.

We are greatly pleased to be able to inform our readers that the article which we are publishing from the Hyperbo-Electric Flow Meter Company comes from an organization which is being managed and directed entirely by Armour Institute alumni.

In a recent letter which has been received from Mr. Naiman the following list of our alumni is included:

Julius M. Naiman, '21, President and General Manager.

Hirsch Epstein, '20, Production and Service Manager.

Clifford L. Burnham, '12, Sales and Advertising Manager.

Morris Wisner Lee '99, Advertising Counsel.

Judd Mitnick, '20, Design and Production Engineer.

Louis Newman, '21, Design Engineer.

Leo Maranz, '21, Service Engineer.

It is our wish that the Hyperbo-Electric Flow Meter Company might enjoy unbounded success.

THE ARMOUR ENGINEER

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EDITORIALS

It is with great sorrow that we announce the fatal injury of one of our fellow students, Harold E. Grigg, Class of '27, Civil Engineering Department.

While crossing in front of a north bound State Street car from which he had alighted, on the morning of February 27, he was struck by an automobile speeding southward on the opposite track.

He was immediately taken to the Providence Hospital where the efforts of Dr. Kelley and the hospital staff to save his life proved futile. He died at 9:15 in the evening.

Harold Grigg was a graduate of the Pullman Free School of Manual Training where he attained an excellent record and reputation. He was well known, well liked and popular among his classmates at the Armour Institute of Technology.

Assemblies, real live, snappy, interesting ones, have been coming thick and fast of late. On February 1, Captain Eddie Rickenbacker recounted his interesting experiences and thrilling adventures as American Ace of Aces on the Western Front.

On February 11 Rev. Frederick W. Shannon, our good old friend and patron, gave the Lincoln's birthday address. Dr. Shannon pays us a visit every year at about this time.

February 21 brought Mr. Julian Arnold, Commercial Attache of the American Embassy in China, who spoke on the very interesting subject, "Opportunities for Young Men in China."

Another extremely interesting discussion of a subject similar in some respects to the last, was presented by Mr. Norman V. Pearce, Australian novelist, poet, and explorer, who talked about "Australia, the World's Curiosity Shop."

Give us more of this kind!

Mr. George D. Conner, Class of '21, was placed first in Architectural Design in the entrance examinations at the Beaux Arts in Paris in March.

In the Second Preliminary of the Society of Beaux Arts Architects of New York, I. Jerry Lobel, Class of '21, was placed first and H. K. Bieg, Class of '22, was placed third. The subject of this competition was "A Summer Hotel," which required the development of the plan in twenty-four consecutive hours of work. They are now two of the five final competitors for the prize and for which they must execute a problem from May 5th to July 16th. The final drawings are made under the supervision of the Committee of the Society in the last two or three weeks in New York City.

The following is a list of interesting problems being worked upon by the Design classes:

Freshmen—A Niche with a Commemorative Tablet for an Architect.

Sophomores—A Study in Vaulting and Stereotomy for the Vestibule of an Important Library.

Juniors—A Reception Room for a Cardinal which is Required in Perspective with a Study of All the Furnishings.

Seniors—A Reviewing Stand and Reception Pavilion with all its approaches and accessories.

The Doorway illustrated on the cover is from the McVeagh House by H. H. Richardson, Architect, which was so generously given to the Armour Institute through the efforts of the Historical Committee of the American Institute of Architects. The ornamental part of the doorway will undoubtedly be incorporated in some feature of the new Armour Institute buildings. Richardson considered this his best piece of decorative detail.

BASKET BALL

Our basket ball season for this year ended with the Lake Forest game at the Armory on February 28. This marks the close of what may be considered a very unsuccessful year from the standpoint of games won. Out of a total of fifteen (15) games played, only four (4) were won by us.

Into every student's mind comes the question of why this is. Could it be that the material was of too poor a caliber to stand the gaff of intercollegiate competition? With three regulars of last year's squad and the largest turn-out of Freshmen for several years, many of whom had won reputations on championship High School teams, it seems as though at least a mediocre team could have been produced.

Were the general playing conditions of the squad up to normal? This year, for the first time, our team had a really good floor to play on and with the start of the season we had high expectations of a successful season as the school gymnasium has long been considered a decided handicap for the training of our basket ball teams. Scholastically, the team was somewhat above the average and no serious cuts were made on the squad because of low scholarship. With the heavy programs that all the players carry, ranging from thirty to forty hours a week, their physical condition is never the best, but that has long been the

Continued on page 94

SOCIETIES

R. M. Beckwith, *Editor*

ARMOUR TECH BAND

The Armour Tech Band is something new. Organized this semester by a group of hopeful windjammers, the band at the present time gives promise of adding one more to the list of successful organizations.

There are fifteen men on the roll and they are all working hard to have a band for Circus day. Rehearsals are held every Wednesday afternoon, and more men are needed.

The Judges of the Song and Cheer Contest conducted by the Armour Tech Athletic Association during the fall of 1922, after serious deliberation awarded the prizes, under the rules of the Contest, as follows:

1st Prize Alma Mater.... E. F. Gillette, '06.
2nd Prize Alma Mater.... E. F. Gillette, '06.
1st Prize Fight Song..... Whitfield and Spaid.
2nd Prize Fight Song..... Professor H. R. Phalen.
1st Prize Cheer .... H. W. Munday.
2nd Prize Cheer .... H. W. Munday.
3rd Prize Cheer .... H. W. Munday.

C. M. Kirkhuff, *Chairman.*

Committee: Kirkhuff, Leigh, Schommer, Nutt, Crane.

WESTERN SOCIETY OF ENGINEERS

The Armour Branch of the Western Society of Engineers continues to present speakers who are an inspiration to those who hear them. On January 18th Professor Kesner of the Civil Department presented a very interesting paper on "What Is an Engineer?" His discussion of the various viewpoints on the subject, and of the lack of a universal definition of an engineer, made the meeting profitable as well as enjoyable.

Because of examinations and change of semesters the next meeting was not held until March 1st. At this meeting Dr. Dignan gave an address on the subject, "Selling Your Services." Dr. Dignan's talks always give us inspiration for greater achievement, and this one will not soon be forgotten. He is a man of wide experience with a national reputation, and his talk had that punch which all engineers need. Dr. Dignan will always find a welcome at Armour Tech. The programs for the remainder of the year will include H. M. Byllesby, Benjamin Bills, J. L. Hecht, and A. M. Van Auken.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The Armour Chemical Engineering Society has been accepted by the American Institute of Chemical Engineers and is the third student body to be admitted This is another step forward and it is expected to benefit the Institute as a whole as well as the members of the society.

A smoker was held in Room D in the Mission on February 2, 1923. The Imperial Jazz Band functioned splendidly, and Mr. Amsbary entertained us with some of his delightful French-Canadian tales. Smokes, with sandwiches, doughnuts, and cider were the other attractions during the evening.

ARMOUR TECH ATHLETIC ASSOCIATION

Among the various enterprises which the Athletic Association has been promoting the work of the Football Committee is perhaps most vital at the present time. A questionnaire was sent to all schools in the country which offer courses in engineering, the purpose being to secure information which the committee needed for their work. The following are some of the questions: Does football support itself at your school? Approximately what expense is involved for coaching, for training, and for equipment, etc.? What percentage of the squad study engineering? What percentage of the team are engineering students? How much practice does your squad get before the opening of school? What amount of practice after school commences? How many games does your team schedule? What is your average attendance for a game? What is the attitude of your faculty toward football? What do you think of the advisability of establishing a football team in a professional engineering school such as ours? What conditions are necessary for a successful football team?

The committee will have a complete report ready by March 22nd. The officers of the Athletic Association are working on a set of rules and regulations that will fill a long felt need. Much of the activity is divided up into the proper departments, such as track, golf, tennis, and swimming. Matters of regular routine are being attended to such as finance, mass meetings, and so forth. Plans for Circus Day are also being made.

THE ORCHESTRA

Let's give a "Yea, Orchestra! Let 'er go! One—Two—Three!"

That's the spirit with which the recent appearances of the orchestra have been received. The remarkable progress made by our musicians of the orchestra of late is the result of many diligent sessions of practice in the Auditorium under the able direction of Mr. F. McCluskey, assisted by H. Altermatt. As a reward for their efforts, several engagements, both at home and away, were secured, two of them in conjunction with the Glee Club.

Since the last issue of the Engineer, the orchestra has taken its place on the program upon six occasions and, as we go to press, are about to fulfill another engagement with the Glee Club at Hinsdale. In order to accommodate all these engagements, so close together, it necessarily meant an enlargement of the repertoire. In consequence, many new selections have been added, among them the "Hungarian Dance," No. 5, by Brahms and "Lilies," by Bendix, two works which have been very well received by the students.

On Friday night, February 23, the orchestra journeyed out to Oak Park to take part in a joint concert with the Glee Club. The inhabitants of Oak Park accorded both Clubs a hearty reception and continued to demand encores throughout the program from the

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FRATERNITIES

R. M. Beckwith, *Editor*

SALAMANDER

"Salamander," an honorary senior society in the Department of Fire Protection Engineering has been organized with the following as charter members:

Faculty Member:

Professor J. B. Finnegan.

Student Members:

O. L. Cox, '23.	J. C. Worley, '23.
R. O. Matson, '23.	G. G. Blair, '23.
C. W. Hauth, '23.	R. M. Beckwith, '24.

ETA KAPPA NU

During the last semester, Eta Kappa Nu has initiated the following men from the Senior and Junior Electrical Engineering classes:

R. D. Fisher	J. H. Goodmanson
E. J. Biever	E. A. Klein
E. L. Carlson	T. E. McDowell
R. L. Coultrip	D. E. Richardson

The banquet given in conjunction with the Chicago Alumni Chapter was well attended, and these men were given an opportunity to show their worth. During their period of pledgeship they did considerable to improve the appearance of the chapter rooms and the Senior Drafting Room.

Harold M. Piety.

THETA XI

On February 3, L. Dean Alber, Chas. W. Barger. Henry M. Harris, Martin C. Hussander, Philip F. Kingsley, H. Walter Regensberger, Murray Russell. Robert C. Sisson, and C. Truman St. Clair were initiated into Theta Xi.

Thursday, February 8th, the newly initiated men were guests of honor at an Initiation Banquet and Honorary Stag at the University Club. Sixty-five brothers of T. X. were present, and among the alumni of our own Chapter were Webster, Canman, Cole. DeCelle, Dowse, Dierking, Eierdam, C. S. Hamilton, Hayden, Maitre, Nothhelfer, Peterson, Penn, Regensberger, Shotwell, Thompson, King, Lake, Pond, Lochow, Stone, Stoker and Turley. Professor Paul. Professor Penn, Truman St. Clair and Fred Dierking responded to calls from our most excellent toastmaster, Addison A. Righter, of Yale.

An informal House Dance held on February 17th attracted forty-four couples, and needless to say, everyone was sorry to hear "Home Sweet Home." Bro. and Mrs. Frank Pond, and Bro. and Mrs. J. B. Nothhelfer kindly officiated as chaperones.

By far the most important and largest stag of the year is set for April 27, for at that time, the fifty-ninth birthday of Theta Xi is to be honored, and we can safely estimate an attendance of more than one hundred Theta Xi Brothers.

PHI KAPPA SIGMA

On February third, after a week of fun and excitement, eight men were initiated into the Alpha Epsilon Chapter of Phi Kappa Sigma. Theodore Boekman, Earl Busch, Donald Davidson, William Dean, Eugene Hedges, Robert Mallory, and Charles Melka stood the acid test of the fraternity and are now enjoying the privilege of wearing the Phi Kap badge.

A house dance in January; a dance given by the Phi Kap Club for the active chapters in Chicago, at the Drake, followed by a buffet lunch at the club house; and an informal dance at the A. E. home have comprised the social events of this season.

Roy C. Jensen, *President*,
A. E. Chapter.

RHO DELTA RHO

Although we were busy preparing for our annual dance on January 27, 1923, all of us came through the terrors of the final exams with our feet firmly on the ground, albeit we were a little battered and groggy.

The annual dance was a sociable affair and will stand as one of the pleasant memories of our lives And now plans for a Dad's banquet are under way, at which we expect to show our fathers that we have learned something at Armour.

BETA PHI

February 17th marked the second annual cotillion party which proved to be a greater success than that of last year. Among the alumni present were: Ira Bready, Roy Malwitz, F. Baird, and Bob Isaccs.

TAU DELTA PHI

At the present time, we are mainly concerned with tackling those casual acquaintances, our textbooks. However, in the interval between the laying down of one book, and the taking up of another, we have found time for smokers, get-togethers, and a Fathers' and Sons' Night. Our dinner-dance, to be given some time in March, promises to be an affair of brilliance to say the least.

DELTA TAU DELTA

Delta Tau Delta announces the coming initiation of pledges on Saturday, March 24th, and Sunday, March 25th. Any alumni of the chapter, or any traveling Delts who can attend the initiation will be more than welcome.

The Western Division Conference of the Fraternity was held here in Chicago on Friday and Saturday, February 23rd and 24th. In conjunction with the conference, the annual Delt Prom was held on Friday evening, the 23rd, at the Blackstone. Dancing prevailed from nine until three to the tune of two orchestras. At midnight, supper was served, and favors passed around.

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GLEE CLUB

After making a very creditable showing in the recent Intercollegiate Glee Club Contest held on February 9 at Orchestra Hall, the Glee Club has turned its attention to outside engagements, and to preparation for the Home Concert.

The outside engagements have been at Oak Park on February 23, and Hinsdale, Ill., on March 2. The programs consisted of a well selected set of songs and were very ably executed with the aid of Mr. Tucker, the director.

The main object in view, however, is the Home Concert, which is to be held on April 27. At the present time no place has been found in which to hold the concert, but a committee has been appointed to investigate and a report is expected soon. The Home Concert this year should surpass the concerts held in the preceding years. The new Activity Fee of the Athletic Association entitles every student to a seat at the Home Concert and this should serve to create a keen interest in the matter.

A number of new men have recently entered the club and are now working hard to help the older members make the Home Concert a big success. The spirit shown by these men is the kind of spirit that "makes" a club. Every man in school who can sing should feel himself bound by a sense of duty to help make the Glee Club at Armour Tech second to none.

H. C. FRIEDMAN, *Secretary*.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Armour Branch of the American Institute of Electrical Engineers holds meetings regularly on the first and third Thursdays of the month at 11:30 a. m. Practically all of the speaking this year has been done by outside men, and we have been very fortunate in securing as speakers the men mentioned below.

On January 11, 1923, Mr. Morrison, of the Acme X-Ray Co., talked about X-Rays. The finals interrupted the regularity of the meetings for a time, and the next meeting came on February 15, when Prof. Nash spoke on "A Problem in Engineering." On March 1, Mr. Grenell, of the Illinois Bell Telephone Co., delivered a lecture on "The Design of Telephone Circuits as Compared with that of Power Circuits."

We are very much indebted to Prof. Moreton for his assistance in enlisting membership and speakers.

HAROLD M. PIETY, *Secretary*.

FIRE PROTECTION ENGINEERING SOCIETY

The society has been as active as the prospects of the first meeting of the year showed that it would be. At our meeting in October, Mr. Stanley Williams of the National Safety Council spoke to us on the work of that organization. He brought out the fact that fire prevention is a problem which has to do with the safeguarding of life as well as of property. He enlarged upon the subject of the protection of life, bringing up the problem as met in the modern industries, and showed that protection of the workers leads to increased efficiency, the saving of compensations, and an increase in the morale of the entire organization.

Mr. R. E. Verner was the speaker at our November meeting. He gave us an insight into the workings of the Fire Prevention Department of the Western Actuarial Bureau.

Mr. Verner is the manager of this department, the duty of which is to educate the public in the need for fire protection and fire prevention.

Early in December we had a short business meeting followed by a very interesting talk on "Coal Storage" by Mr. Carl Eppich. This was the first of the talks by the students which are being planned for the future

At our most recent meeting, Mr. J. V. Parker, Manager of the Western Actuarial Bureau and Chairman of the Fire Insurance Scholarship Committee, spoke to us. He emphasized the important part that a thorough college training has in the preparation of a man for the profession. At the conclusion of Mr. Parker's address, Mr. R. T. Nelson produced his moving picture machine and showed two films, such as are being used in the educational campaign for Fire Prevention.

Continued from page 88

playing of the first orchestral piece to the singing of "For Armour" in conclusion. The orchestra was encored upon both appearances and recognized them by trying to "raise the roof" with two marches, including the "Stars and Stripes," by Sousa.

The sixth and last showing of the orchestra, as we go to press, is the assembly of March 1st. At present all indications point to a successful showing of the orchestra at the Home Concert which it is now looking forward to as its triumphal accomplishment of the year.

SIGMA KAPPA DELTA

Sigma Kaps held their annual "Dads' Night" smoker on February 10, 1923. Movies, stunts, and a radio concert entertained the paters. Several of the alumni were there, among them: L. L. ("Doc") Edlund, Al Edwards, E. M. Seaberg and J. C. E. Vaaler.

The coming events on our social calendar are a house dance on March 10, and the annual Faculty Smoker on March 23.

SCROLL AND TRIANGLE

The activity at the Scroll and Triangle House during January was somewhat subdued. The "exams" were to blame. One Smoker was held during January. February proved to be a more active month. On February 5th a banquet was held in honor of several prominent engineers. A Dinner Dance was held on February 17th. Initiation week was held the week of the eighteenth. Something was doing every night of that week as those that "hit the trail" can testify. The following men were initiated: McDowell Beck, Treff, Montgomery, Hoff, Olson and Flenner.

Continued from page 89

We are looking forward to entertaining the Faculty on Friday, March 9th, and plan to show them a good time. And the following week, all alumni of our chapter are invited to attend a house dance. We can assure you of a great time.

Our scholastic standing, compiled this last week, is a source of gratification to the chapter. It is somewhat above 85%.

The chapter is looking forward to continued good fortune, and expects a 100% turn-out of alumni for the May 10th anniversary party.

R. O. BRADLEY.

VACUUM TUBES AND THEIR FUTURE

By

G. M. Wilcox, *Professor of Physics*

The vacuum tube as a generator of alternating current for use in radio communication has recently become familiar to the general public as well as to engineers. The ordinary power tubes are capable of supplying only a small output, usually not exceeding a few hundred watts.

For large sending stations intended for long distance communication, a large number of such small tubes would be required, and other sources of high frequency electric currents, such as the Poulsen arc and the Alexanderson generator, have been employed instead of tubes. Engineers of the Bell System Research Laboratories and of the General Electric Co. have recently developed power tubes giving an output of up to 100 K. W.

The engineering problems encountered in the construction of such tubes are many. The tube must be water cooled because of the large amount of heat produced when it is in operation. To accomplish this a method was devised whereby glass and copper may be sealed together without danger of separation when the joint is subjected to considerable changes of temperature. To install the heavier metallic parts in the tube and seal the glass and copper joints it was necessary to devise special mechanical apparatus.

In order to obtain a permanent vacuum it was found necessary to preheat the metal parts in a special vacuum furnace before placing them in the tube. This was done to get rid of the large amount of gas occluded on the surface of the metal.

The anode of the 100 K. W. tube is of seamless copper tubing sealed to the glass and water cooled. The grid is of molybdenum and the filament is of tungsten. The power used in heating the filament is 6 K. W., the current required being 91 amperes. The voltage used in the plate circuit is 10,000 volts.

Recently the engineers of the Radio Corporation of America substituted a vacuum tube sending set made by the General Electric Co. for the regular Alexanderson generator used in trans-Atlantic transmission at Rocky Point, L.I., and used it continuously for sixteen hours. The operators in charge of the sending keys were not aware of the substitution, and the receiving operators in England and in Germany apparently noticed no difference.

BOOK NOTES

Recent Additions to the Library—of Interest to Faculty and Students:

Adams, J. Q.—"Shakespearean Playhouses."
A history of twenty-two English theaters. Interesting to all interested in English literature, as well as students of Shakespeare.

American Association of Engineers—"Publicity Methods for Engineers."
"The purpose of this book is to make plain the principles of presenting to the public information about engineers."

Bacon, R. F. and W. A. Hamor—"American Fuels."
This is a complete summary of the characteristics and economic utilization of various kinds of fuels, interpreted according to modern practice for the chemical and mechanical engineer.

Bell, Louis—"The Telescope."
"This is the first adequate publication since Sir William Herschel's treatise."

Best, William N.—"Burning Liquid Fuel."
"A practical treatise on the perfect combustion of oils and tars, giving analyses, calorific values and heating temperatures of various gravities of fuel."—*Transactions of the American Society for Steel Treating.*

Broderick, J. T.—"Pulling Together."
A discussion of a plan rapidly growing in favor for the better co-operation of capital and labor.

Bugee, E. E.—"Fire Assaying."
Originally prepared for use in the course in fire assaying at the Massachusetts Institute of Technology.

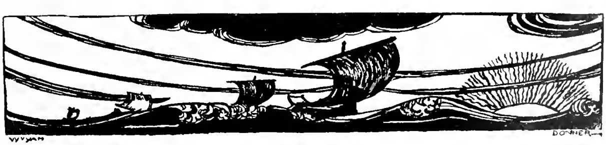
Campbell, N. R.—"Physics—the Elements."
A systematic treatment of accepted doctrines, showing clearly the fundamental proposition on which they are based.

Clark, F. C.—"Principles of Marketing."
A discussion of the most fundamental problems and principles of the marketing process.

Day, D. T.—"Handbook of the Petroleum Industry."
This subject of growing interest is fully covered, from the taking up, the prospecting and locating of oil lands through the methods of testing, transportation and refining.

Hardenburg, W. E.—"Mosquito Eradication."
The book takes up every phase of the problem, and contains much material of value to the sanitary engineer.

Polakov, W. N.—"Mastering Power Production."
A book of interest and value to the engineer, economist and student. The examples, while drawn from the field of power production, may be applied to mastering production of any kind.



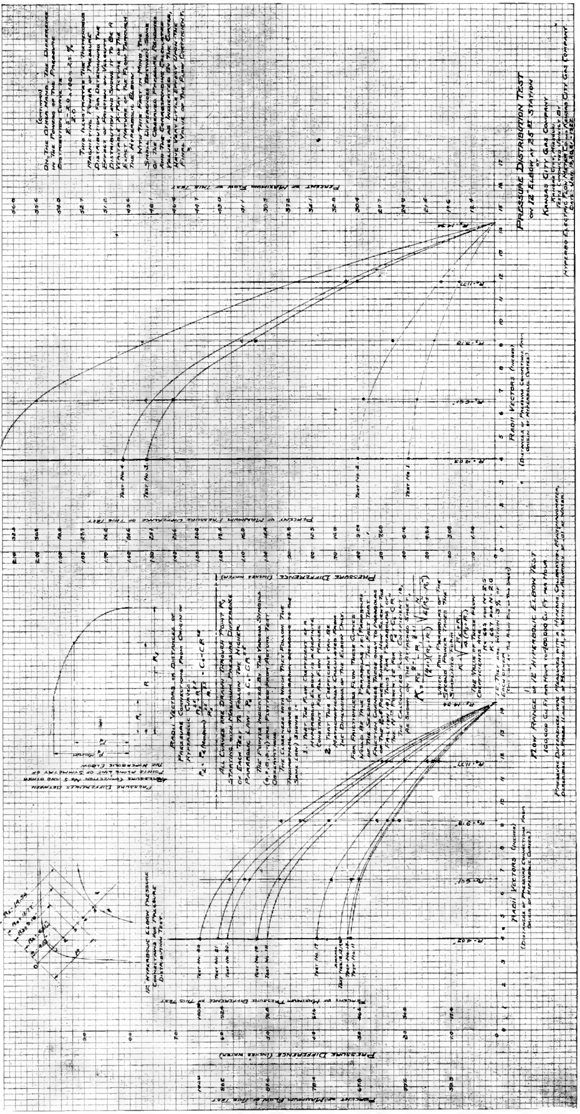


Figure 2

Pressure distribution curves obtained from data resulting from tests on the 12 inch Hyperbolic Elbow, installed at the 25th Street Station of the Kansas City Gas Company, Kansas City, Mo.

Continued from page 83

per hour for a 12 inch line under 15 pounds per square inch pressure involves a very high velocity. And if the lower velocity range is analyzed, it is apparent that if anything there is a tendency for the effect of friction to decrease. This would only tend to cause the $2\frac{1}{2}$ power parabolic pressure distribution curves to approach those of frictionless flow, or parabolas of the second power, with a maximum possible flow coefficient change of 0.3 per cent. Considering the fact that no such change of curves is noticeable even at 24 per cent loads, what are the probabilities of the occurrence of these changes for loads ranging between 24 per cent and 5 per cent? And if there is some slight change what harm would this cause when at the worst the flow coefficient error may be 0.3 per cent.

As they say in the courts, the attorney for the defense now rests his case with jury, and leaves for them to decide whether these facts do not prove our contention that,

(1) The flow coefficient of a *Hyperbolic Elbow* is a *definite* constant for *all* ordinary flow ranges, and that

(2) This coefficient can be calculated from the *dimensions of the elbow only*.

In Figure 4 it is illustrated how this flow coefficient may be calculated from the dimensions of the hyperbolic elbow, and how it is affected by the power, N, of the pressure distribution curve,

$$P_d = C_o - CR^n.$$

Besides the pressure distribution tests mentioned, many other tests were made on the 12 inch elbow in Kansas City, furnishing a complete analysis of the gas flow through the elbow. After these numerous tests were completed, the consistency and definiteness of the flow coefficients of hyperbolic elbows for gas was proven beyond any doubt by the consistent results of these tests.

Finally, it was decided to make a real check of the calculated flow coefficient of a hyperbolic elbow against some absolute measurements, namely with a gas holder. Following this plan, four complete holder tests were run off, each seven hours long. An 8 inch hyperbolic elbow was used, and the flows measured were from 80,000 to 135,000 cubic feet per hour, or from about 60 to 100 per cent of maximum load. In these tests primary interest obtained in checking the calculated elbow coefficient for a fair load range rather than in testing electrical meter accuracy. The latter tests can be made much more easily in the shop or laboratory. In three of these tests, the complete run of accuracy of the Hyperbo-Electric Flow Meter was within 0.25 per cent, while in the fourth test it was within less than 1 per cent. A copy of the data sheet and calculations for one of these tests is shown in Figure 6.

It is when experimental engineering makes such a perfect check of a theoretical idea, that one feels fully rewarded for years of hard work and effort. It took over four years to develop the Hyperbo-Electric Flow Meter to its present stage.

The solution of the problems of accurate measuring of pressure differences, developing an electrical recorder, determining the factor of density as affected by static pressure, temperature and specific gravity will be discussed in a succeeding article.

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The contractor has practically nothing to sell but service and judgment. He is not infallible any more than the architect or the engineer who is responsible for the plans, and there is no reason why the contractor should be called upon to take all the risks which make him nothing but a gambler. The owner who is willing to assume certain of the risks which have been so industriously exaggerated by lump sum contractors will profit largely by so doing, while at the same time getting what he wants, when he wants it, knowing that he is paying for it only what it is worth.

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function of the absolute temperature pressure and specific gravity of the gas; hence, by making corrections for such of these factors as vary, the volume or the weight of a gas may be obtained for some standard conditions while the measurements may be made under other conditions.

By referring to Fig. 5, it is seen that there are three resistances, R_1, R' and R'', one or more of which may be varied with a corresponding variation in the speed of the meter. It thus becomes possible to change these resistances, automatically or otherwise, with changes in pressure temperature or specific gravity. For example, the resistance R^1 might be varied with the pressure through a considerable range without appreciably changing the total impedance between A and B as fixed by the velocity of the flow. The indications of the meters are in this manner corrected for pressure. In a similar manner, corrections for temperature or specific gravity may be made by using the resistance R'' or R_1.

We thus have an integrating meter giving an electrical quantity proportional to the amount of fluid passing a given point, practically independent of the ordinary variations in voltage and frequency and which may be corrected for any changes in density. The instrument is very simple in construction and from all indications, it appears to be quite permanent in its calibration.

Continued from page 87

situation at Armour and would not make such a decided difference in one year's record.

Were our men properly trained? This is something hard for the casual observer to decide with fairness. Even the most cynical student will not say that our team did not fight. Our team needs no "fight song" to inspire it with the will to win. No, it is not the fact that their morale was low but that it was useless; and there is no more saddening sight in athletics than to see a team fighting blindly, hopelessly to defeat.

With the desire that our activities in all lines shall have the best opportunity possible for their development, we have instituted the Armour Tech. Athletic Association. It is the duty of this organization to investigate unsatisfactory conditions and take the steps necessary to remedy them. So it is that the student body plead or rather charge the Association to "seek ye and find" that whatever is the cause of our poor showing in basket ball, may be eliminated and that next year we will come back with all the fighting spirit the Armour Spirit, that was shown this year and show a goodly factor of safety at the end of the season.

Engineering Sells, Too!

A whole lot of the make-believe has been eliminated from selling operations in the past ten years. The old idea that salesmen were born to the sample-case, that they carried some sort of a special diploma from the University of Pooh, has had to break camp, along with the other exploded theory which insisted that a salesman must be a "good fellow", a man of strange habits, tremendous stories, and unquestioned qualities both as a mixer, and as an assimilator.

Now we believe—nay, we *know*—that the best salesman is the man who knows most about his goods, and can talk most *interestingly* about them.

This being the proven case, it isn't so queer that engineering should find a real and effective application in the selling field, especially if the merchandise marketed is an engineering product that is bought and operated by engineers.

Every engineer who now engages in the sale and distribution of Westinghouse products feels that he is doing work worthy of his training—for he is carrying Service and Sincerity to Industry, and to mankind! He is out where the fighting is often the fiercest, and he is putting up a battle for the things that he believes are right. And a man can't expect, nor ask, a bigger chance than that!

Sixty percent, approximately, of the engineering graduates who come to Westinghouse find their way eventually into some phase of selling. And we are proud to have them there—and they are glad to be there!

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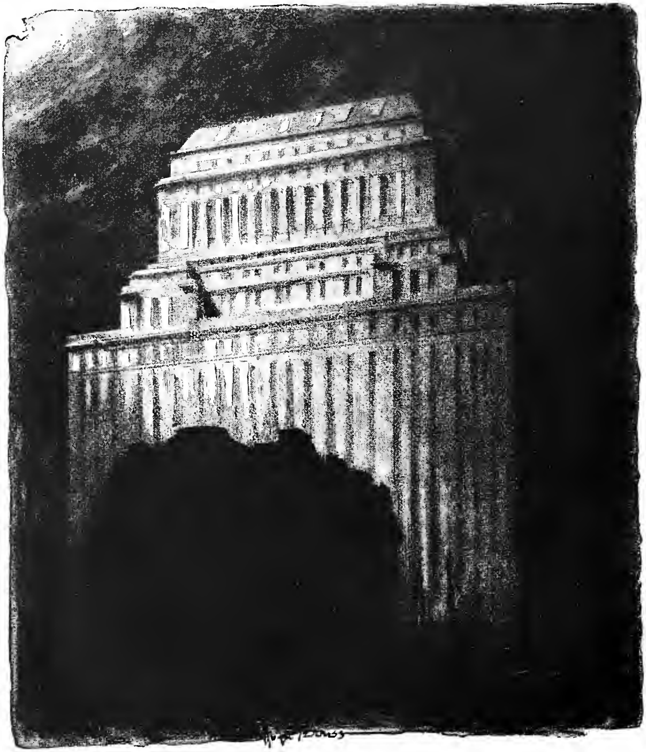
(*Signed*) LESTER E. GRUBE.

Sworn to and subscribed before me this 8th day of November, 1922.

(*Signed*) GEO. S. ALLISON.
Notary Public.

CHICAGO, November 8, 1922.



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THE ARMOUR ENGINEER

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ENGINEERING MAJORS

By

Charles Robert Birdsey

Chief Engineer, The U. S. Gypsum Company

Mr. C. L. Birdsey, a graduate of Lewis Institute, began his career some fifteen years ago as "one of the engineers" of the U. S. Gypsum Company. While on a mill erection job in a western state an accident occurred, in which he lost his left hand. In connection with this he tells the following story: "Lying in the bunk house under the care of a 'Jack-of-All-Trades,' thinking my engineering work on this earth was done, I had visions of losing my job. However, on the fifth day I received proper medical aid, and, better still, a telegram from the 'Chief,' saying, 'Now that you have lost your hand you will have to use your brains. Hence you are worth more money to us.' "

This terrible misfortune was really the starting point of Mr. Birdsey's career, for it forced him to use his head instead of his hands. In due time he received the raise promised him in the chief's telegram, and from that time on climbed steadily upward to his present important position.

THE life that the average engineer has to live and the responsibilities that he has to carry demand the best in both mental and physical equipment. The student who is preparing himself for that sort of a life should know what these demands are, and be urged to prepare himself for them. When he goes to the average engineering college or university his main aim is to master all phases of the subjects that are given to him in the usual course of his studies. He can very seldom go wrong in choosing the studies which must consume his time. In fact, he is surrounded with so many regulations and scholarship demands, that, it is safe to say, nothing will be neglected in his college course if he simply follows out the requirements that are demanded by his school and his instructors.

As I look back over twenty years of work, and review with some of my co-workers the various phases of the life of an engineer, I realize that there are many other factors that are necessary to equip properly a man for this kind of a job. These factors rank far ahead of his detailed engineering education. They mean more to him in successfully attaining his goal and happily enjoying his life.

I am placing these factors in the order of their importance, as they appear to me personally.

The practice of engineering demands great physical endurance. The fellow who is climbing ahead in his profession meets with all sorts of privations and disturbed living conditions. His field of operation is the entire world. To cover this field he is forced to travel over wide areas and to all sorts of places. He eats excellent food one day and the poorest of "chuck" the next. He sleeps in the finest of beds today, and tomorrow he may be tied up in some construction camp, sleeping between damp blankets; very often he gets no sleep at all. Through it all the young cub must carry a well body, which is needed to house an alert mind. In the job that he has ahead of him the most important tool that he has to work with is his body. It is, therefore, extremely important that he develop it properly. This means that it must not be abused either morally or physically. He should study it as he would the most intricate piece of machinery, and know its finest detail requirements for maximum output. He should make it the best piece of well groomed, orderly and efficient machinery within his power. He should study its requirements for maximum efficiency, and heed them. He should give it the care and attention that common sense and teaching tell him that it should have. It is the best piece of highly co-ordinated machinery that will ever be given to him to develop, perfect, and handle. It is given to him exclusively. Its abuse will hurt nobody except himself. It is also, by the way, the finest piece of machinery that will ever cross his path again. If he cannot handle it properly he is going to have a mighty hard job in the future in handling other responsibilities that are given to him. It is a big job, but it is the most important one that he will ever have. It means that he must keep his morals right, his exercise regulated and sane, his food well selected and properly eaten, and his hours of work and rest regular and well balanced. If it is necessary to fail in some of his engineering credits to accomplish this, he will be a

Mr. C. R. Birdsey

Continued on page 126

MEASUREMENT OF FLOW

PART 4

By Julius M. Naiman, '21,
President, The Hyperbo-Electric Flow Meter Co.

NEXT in importance to an accurate source of pressure difference characterized by a predeterminable flow coefficient constant for all ordinary loads, comes the problem of a rugged, accurate method of measuring this pressure difference and any other factors which may be involved when we attempt to measure the flow of fluids.

As was brought out in Part 3, the Hyperbolic Elbow furnishes us with a source of pressure difference whose flow coefficient, K, is a definite predeterminable function of its dimensions. The final relation between this measurable pressure difference and flow was shown to be

$$v_a = K\sqrt{2gH} = K\sqrt{2g\frac{P_d}{D}} \quad \ldots\ldots\ (1)$$

$$Q = Av_a = AK\sqrt{\frac{2gP_d}{D}} \quad \ldots\ldots\ (2)$$

$$W = DAv_a = AK\sqrt{2gP_dD} \quad \ldots\ldots\ (3)$$

where, v_a = average velocity through the plane of symmetry of the elbow

K = flow coefficient of the elbow

H = equivalent velocity head corresponding to the average velocity.

P_d = pressure difference corresponding to the velocity head H

D = density of the fluid

A = area of plane of symmetry rectangle

Q = flow of the fluid, in cubic feet per second

W = flow of the fluid, in pounds per second.

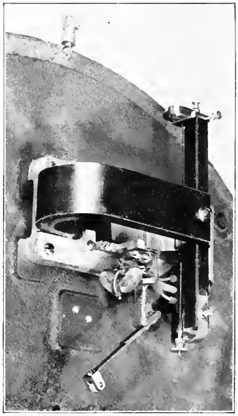
An inspection of the expressions for either the flow in cubic feet per second or that in pounds per second will indicate that besides pressure difference, P_d, there is also the factor of density, D, to be measured. In the case of wet or saturated steam, the prevalent variations in steam pressure, with corresponding changes in steam density, make it necessary to make automatic corrections for these variations, if the flow metering is to be accurate. Similarly in the case of superheated steam and air, temperature in addition to pressure variations must be corrected for, while in the case of gases, specific gravity as well as pressure and temperature variations, must be taken into consideration. Our problem then is:

(1) Finding rugged, accurate means suitable for the automatic measurement of pressure difference and of the other factors.

(2) Automatic recording of the combination of these factors in convenient directly legible units of flow.

Now, it was felt that the electrical method of measuring pressure difference, while superior to the mechanical method in that it was free of objectionable friction and unavoidable lag, was itself objectionable because of the prevalent practice of causing the movement of mercury produced by the pressure difference to vary electrical resistance and then turning right around and measuring the current flowing through this resistance instead of the resistance itself. This made the accuracy of measurement subject to a constant voltage, which is never found in practice but which may vary from 5% to 10% from its average value.

It appeared to be so much more logical to measure the resistance itself. The commercial fact that inexpensive ammeters can be bought ready made, while an inexpensive ohmmeter is unknown, suggested the developing of a rugged, accurate, automatic ohmmeter, even though it took years to do it. The satisfaction of doing all the experimental work at our own instead of the customer's expense; that of giving to the engineering world a truly superior product which would mark an epoch in the history of flow metering because of its ruggedness and accuracy; that of raising its standard of accuracy to a point higher than that of power plant ammeters, volt meters or watt meters — the satisfaction of accomplishing all of this made the effort well worth while.



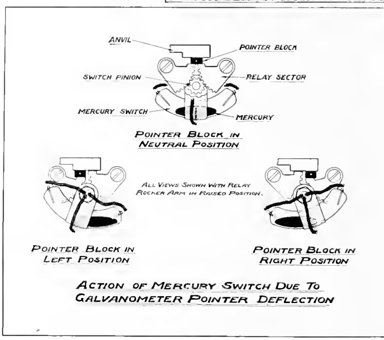


Figure 1—Galvanometer and Relay

The method chosen for the automatic measurement of resistance was the Wheatstone Bridge method of balancing the unknown resistance affected by pressure difference against a known variable resistance, their relationship being fixed by the ratio arms of the bridge. Since the balance is obtained only when the galvanometer reads zero, any variation of the voltage applied to the circuit is of no importance—a characteristic of all "zero methods" of measurement. The problem then was how to utilize the deflection of the galvanometer due to change in flow for automatically moving the balancing rheostat until the galvanometer returns to zero, and how to reverse the direction into which the rheostat arm is moved when the galvanometer deflection is reversed.

The solution of this problem was found in the invention of the so-called "galvanometer relay," illustrated in Fig. 1.

This relay consists of a suspension type galvanometer whose suspension is over ten times the strength of the portable type galvanometer and which will outlast the commercial pivot type ammeter or voltmeter, but which is still of sufficient sensitivity for all practical purposes, because of the comparatively high voltage (over 30 volts), furnished to the Wheatstone bridge circuit by a permanent magnet d. c. generator located in the electrical recorder. The horizontal pointer of this galvanometer carries a metal block at its end, which may be periodically pressed vertically against a stop or anvil without affecting the angular deflection of the galvanometer pointer. About every second, the angular position of the galvanometer pointer is tested by a rocker arm which tends to press the galvanometer pointer block against the fixed stop or anvil. This rocker, which is periodically lifted by a continuosly rotating cam, carries two gear segments meshing with a common gear pinion, upon which is pivoted a two-way mercury switch. Either gear segment can be pressed down causing a rotation of the mercury switch pinion in either direction, except when both gear segments are pressed upon simultaneously, which happens when the galvanometer pointer block is in the center.

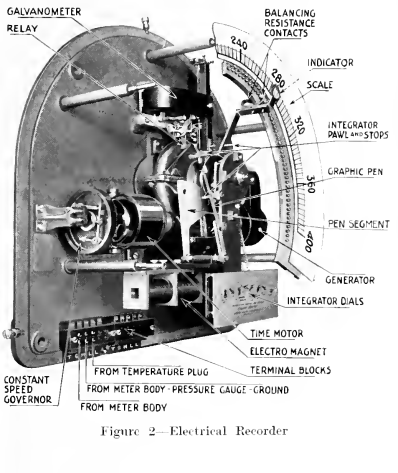


Figure 2—Electrical Recorder

If, however, the latter is deflected due to, let us say, an increase in flow, only one gear segment will be pressed down when the rocker presses the deflected pointer block against the anvil, and this will cause the mercury switch to rotate in such a direction that it will close an electric circuit which will tend to turn the balancing rheostat arm until the resistance *increase* is sufficient to bring the galvanometer pointer back to zero. When this happens, the pointer block is next time pressed against both gear segments, thus bringing the mercury switch to neutral and stopping the movement of the balancing rheostat. A decrease in flow will reverse the galvanometer pointer deflection, will reverse the turning of the mercury switch and the movement of the balancing resistance until released by the return of the mercury switch to neutral, because of both gear segments being pressed upon by the galvanometer pointer block, when the latter returns to neutral.

The whole recorder mechanism illustrated in Fig. 2 is motor driven by a rugged ball bearing series motor, which can be supplied for either d. c. or a. c. or even for 32 volts farm lighting systems. This eliminates all worry about friction of any moving parts in the recorder and also serves to accomplish the following several important objects:

(1) This motor drives the graphic charts once in 24 hours or in 7 days, as may be chosen, eliminating clock troubles and the necessity for clock winding. Its speed is kept constant by a centrifugal governor which throws in or throws out a resistance of the motor circuit, as the speed goes up or down respectively. This patented governor is very rugged, simple in construction, and accurate, allowing the constant speed to change only 1¼% when the voltage varies as much as 10% above or below the average.

(2) The motor also drives the d. c. generator which supplies the voltage for the Wheatstone Bridge circuit.

(3) It also rotates the cam which lifts the rocker arm periodically to test out for the position of the galvanometer pointer.

(4) Then again it operates the patented integrator illustrated in Fig. 3.

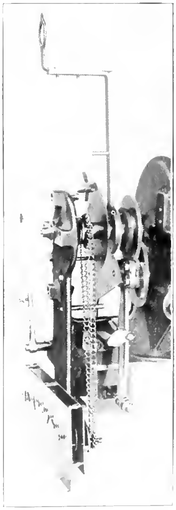


Figure 3—Integrator

The basis of integration used is a continuous addition of indicator readings at definite intervals of time. Every five seconds a motor driven, continuously rotating arm with a pivoted pawl at its end makes a complete revolution, being engaged with an integrating

ratchet wheel during a part of these five seconds proportional to the angular deflection of the indicator arm. The pawl is automatically engaged with the ratchet wheel at a fixed zero position and remains engaged with it until disengaged by a stop on the indicator arm. The angle through which the ratchet is thus turned is therefore exactly equal to that of the deflection of the indicator arm from its zero position. Since the indicator scale is made exactly uniform, the deflection is directly proportional to the indicated load. For full load, the angular movement is 240°, and because this movement occurs every five seconds, the speed of rotation of the integrator dials, connected by a chain with the integrating ratchet wheel, is such that its movements are actually noticeable, the integration of every 1,000 pounds of steam or even less being readable "directly," with no constants to worry about.

(5) Finally, the same motor drives the balancing rheostat arm gearing with the indicator pointer and graphic pen, as illustrated in Fig. 1. This gearing is normally disengaged from the motor continuously rotating gearing and becomes engaged with the latter only when pulled by the electromagnet in one direction or the other, depending upon which way the mercury switch is turned, and which side of the electromagnet the mercury switch thus energizes. The balancing arm, it will be noticed, travels over a horseshoe shaped 240° ring, about 16 inches in diameter, moulded out of Redmanol, with a large number of contacts (168) inserted into the mold, and with a corresponding number of resistance elements soldered between adjacent contacts. This arm carries, besides the contact brushes, the flow indicating pointer.

It will thus be seen that the electrical recorder is a very rugged, self-contained motor-driven automatic ohmmeter, both indicating and recording with the addition of a most accurate sensitive and rugged integrating device. The only attention it requires is changing the motor brushes and oiling the ball bearing once in six months, although oiling even once a year is sufficient. An efficient service department renders to users of Hyperbo-Electric Flow Meters a service comparable to the quality of the meters.

With an accurate satisfactory resistance measuring device thus made possible, our next problem is causing the various factors of pressure difference, static pressure, temperature and specific gravity, to change electrical resistances and then combining these resistances in such a way that the balancing resistance of the Wheatstone Bridge circuit should be a definite function of the measured flow.

A moment's study will disclose the fact that (1) the product or ratio of pressure difference, Pd, and density, *D*, is involved in the equations for flow in cubic feet and pounds per second, respectively (see eq. 2 and 3), and that (2) in the case of superheated steam, air and gases, density, D, in turn involves the product and ratio of the static pressure, absolute temperature and specific gravity; e. g., in the case of gases,

$$PV = BT = \frac{53.34\ T}{S} \quad (4), \text{ and}$$

$$D = \frac{1}{V} \quad (5)$$

where P = pressure, pounds per square foot, absolute.
V = specific volume, cubic feet per pound.
T = temperature, °F. absolute.
S = specific gravity of gas.
B = gas constant.
53.34 = gas constant for air.
D = density, cubic feet per pound.

The final equations for flow must therefore also involve a combined product and ratio of pressure difference, static pressure, absolute temperature and specific gravity. Thus it can be shown that

$$Q_s \text{ is proportional to } \sqrt{\frac{P_d\ P}{ST}} \quad (6)$$

$$W \text{ is proportional to } \sqrt{\frac{P_d\ PS}{T}} \quad (7)$$

where Q_s = flow, standard cubic feet per hour.
W = flow, pounds per hour.

Our problem then was to find an automatic method for measuring the combined products and ratios of several variable factors. The utilization of the multiplying and dividing properties of the Wheatstone bridge circuit for flow metering was then conceived. For, when the galvanometer of such a circuit is balanced, the ratio of any two adjacent arms of the bridge is the same as the ratio of the remaining two adjacent arms. Therefore, by causing three resistances to vary directly in proportion to pressure difference, absolute pressure and temperature, respectively, and then connecting these resistances properly to make three arms of a Wheatstone bridge circuit, the fourth may be made the balancing arm of the electrical recorder, which will thus automatically measure the combined product and ratio of the three factors mentioned, or the *flow* of, let say, the steam, *directly*. The square root effect can be taken care of in the recorder itself by the proper resistance layout along the horse show mold. Because, in addition, the contact spacing along the mold may be varied, it can be so designed that the indicator scale is *perfectly uniform*, so that the first 10% of the scale takes up as much room as that from 90% to 100%—a very desirable feature.

But, since the ordinary Wheatstone bridge circuit has only *three* possible variable arms in addition to the balancing arm, when specific gravity becomes a factor, as in the case of gases, we need *four* variable arms, or we are one arm short. To meet this shortcoming of the ordinary bridge, the Logarithmic Wheatstone bridge was invented. Use was made of the principle that the sum of logarithms of any number of variables is equal to the logarithm of their product. Therefore, if we make a number of resistances proportional to the *log.* of pressure difference, pressure, etc., instead of *directly* proportional, as was previously done, and if we connect these resistances in series, then by measuring their sum with our recorder, we shall be recording the *log.* of the product of all these factors. And if some of these resistances are connected in adjacent instead of the some arms, one of these two arms containing the balancing rheostat of the recorder, the latter will be measuring the combined product and ratio of as many factors as our heart desires, since there is no limit as to how many resistances we may connect in series. (See circuit in Fig. 4.)

The Logarithmic Wheatstone bridge circuit thus furnishes us with a simple means for automatic multiplication and division of an unlimited number of variable factors. To fully appreciate this point, let us analyze the possibility of doing this by connecting resistances in any series or parallel combination (outside of the Wheatstone bridge circuit) and by making each resistance to follow any function of the variable it measures (outside of the *log.* of this variable). If an increase of two resistances is wanted with an increase of, let us say, pressure difference and pressure, respectively, this can be easily accomplished. But whether the *amounts* of increases of these resistances are such that their product, let us say, is still the same function of the products of pressure difference and pressure as at the start, is a different story. To illustrate, suppose that we make one resistance, R_1, proportional to the square root of pressure difference, P_d, and another one, R_2, proportional to the square root of density, D; i. e., let,

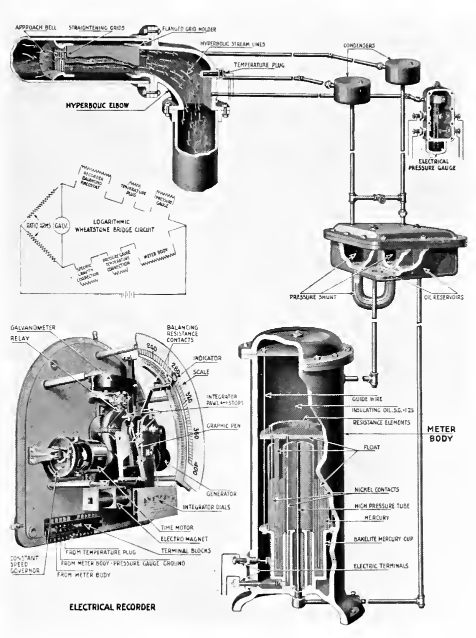


Figure 4—Diagrammatic Layout of the Hyperbo-Electric Flow Meter (Steam)

$$R_1 = K_1 \sqrt{P_d} \qquad (8)$$

$$R_2 = K_2 \sqrt{D} \qquad (9)$$

Now, suppose we want to connect these resistances electrically in such a way that their resultant, R, is proportional to $\sqrt{P_d D}$ of to the flow W, which is proportional to the latter quantity (see eq. 3). If we connect them in series, we get,

$$R = R_1 + R_2 = K_1 \sqrt{P_d} + K_2 \sqrt{D} \qquad (10a)$$

and if $K_1 = K_2$, we have,

$$R = K_1 (\sqrt{P_d} + \sqrt{D}) \qquad (10)$$

which is an addition instead of a multiplication effect. Or suppose, we connect them in parallel. Then we get:

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R} = \frac{K_1 K_2 \sqrt{P_d D}}{K_1 \sqrt{P_d} + K_2 \sqrt{D}} \qquad (11a)$$

and if $K_1 = K_2$, we have,

$$R = \frac{K_1 \sqrt{P_d D}}{\sqrt{P_d} + \sqrt{D}} \qquad (11)$$

which is still not a pure and simple multiplication effect.

Only by utilizing a definite physical or mathematical multiplying and dividing property similar to that of the Wheatstone bridge circuit or of the Logarithmic function, can we obtain true and accurate automatic multiplication and division. Any empirical method is only a rough approximation, leading to considerable error, the percentage of error depending upon the range of variation the automatic correction is intended to cover.

Besides its automatic multiplying and dividing properties, the Logarithmic Wheatstone bridge circuit makes possible a new order of relative accuracy of measurement; viz., the percentage of accuracy attainable at any given reading is within 1% to 2% of *actual meter reading*, instead of meter *full scale*.

Now, such commercial electrical instruments as indicating and graphic ammeters and voltmeters, are guaranteed by their manufacturers to be accurate within 1% to 2% of *full scale*. At 10% of meter rating, this corresponds to a possible error of from 10% to 20% of the *actual reading* of such instruments.

The Logarithmic Wheatstone bridge makes it possible for the Hyperbo-Electric recorder to have (1) a maximum error of *1%* of *actual reading* for loads ranging between 40% and 100% of maximum, (2) a maximum error of *2%* of *actual reading* for loads ranging between 15% and 40% of maximum, and (3) a maximum error of *4%* of *actual reading* for loads ranging between 5% and 15% of maximum. Never has a commercial electrical instrument been offered as yet of such high accuracy, with such a rugged construction!

The secret of this property of the Logarithmic circuit is made clear, if we take any rate of flow, W,

which let us say, is n% of the maximum flow, W_m, and analyze the fact that the corresponding value of the balancing rheostat, *R*, is proportional to the *log.* of this flow, i. e., we have,

$$R = K \log. W = K \log. \frac{n}{100} W_m \qquad (12)$$

where, K = constant of proportionality. Now, suppose that the load change is 1% of its actual value. Then the corresponding change in resistance, ▲ R, is,

$$\blacktriangle R = K \log. 1.01 \left(\frac{n}{100} W_m\right) - K \log. \left(\frac{n}{100} W_m\right) =$$

$$= K \log. \frac{1.01 \left(\frac{n}{100} W_m\right)}{\left(\frac{n}{100} W_m\right)} = K \log. 1.01 \qquad (13)$$

or a *constant* independent of the per cent load, n, under consideration. Thus, in the Hyperbo-Electric Flow meter circuit, a change in resistance of *6½ ohms corresponds to a 1% change in actual load at any point of the scale.* Similarily, *13 ohms* corresponds to a *2%* and *26 ohms* to a *4%* change of *actual load*, and the only limit of accuracy is the number of contacts which may conveniently be inserted into the horse shoe mold of the balancing resistance, since galvanometer sensitivity is not lacking. In fact, for lower loads, because of the decreased resistances of the bridge arms, the voltage across the galvanometer for a given resistance change is increased, and the galvanometer is too sensitive, requiring automatic shunting for the lower load ranges.

Another advantage of the Logarithmic circuit is that by adding a constant calibration resisitance in the proper arm, all the meter readings are increased or decreased a definite percentage. This is utilized for eliminating objectionable multiplying constants so common in flow meters. Thus, suppose that the meter as it is requires a multiplication by, let us say, *83.7* to give thousands of pounds of steam per hour. If we add to the calibration resistance, R_5, an amount equal to—

$$\triangle R_5 = K \log. 83.7,$$

the readings of the meter will automatically be multiplied by *83.7* and will correspond to thousands of pounds directly, eliminating the need of any inconvenient multiplications. This makes it possible to use standard printed scales covering all ordinary flow ranges and reading directly in any convenient units, such as thousand pounds per hour, thousand standard cubic feet per hour, etc., and integrate in similar units or in dollars, which is desirable in cost accounting of steam distribution to various departments or in selling and buying steam.

There are many other advantages of the Logarithmic circuit too numerous to mention. Its great value is thus apparent.

With the choice of the resistance method of metering flow, with the solution of the problem of finding a satisfactory automatic method of measuring resistance, and with the invention of a most flexible method of automatic multiplication and division of the various factors affecting flow measurement, by making the resistances measuring these factors follow a definite law, the next problem was the design of various devices in which electrical resistance might have been varied by pressure difference, static pressure, absolute temperature and specific gravity, respectively.

The result was the invention and development of the
Electrical Meter Body,
Electrical Pressure Gauge,
Electrical Temperature Correction Device,
Electrical Specific Gravity Correcting and Measuring Device.

The electrical meter body used for causing pressure difference to vary resistance, consists of a semi-steel cylindrical shell inside of which is a movable bell float carrying a set of specially treated nickel contact rods of graduated lengths with electrical resistances connected between them and a stationary insulated mercury well into which the contact rods project, these contact rods moving in and out of the mercury as the float rises or falls with increase or decrease of pressure difference, respectively.

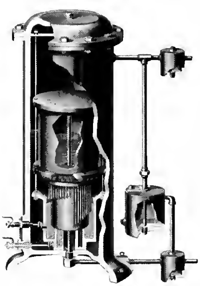


Figure 5—Gas Meter Body

In the case of the gas meter body (Fig. 5), the float consists of two cylindrical parts, one above the other, rigidly joined together. The upper or bell portion floats in an insulating oil, heavier than water, which nearly fills the meter body above the stationary mercury cup, while the lower portion floats in the mercury of the mercury cup. The lower portion also supports the nickel contacts with their resistance elements.

Thus, when the float rises or falls as a result of varying pressure differences, corresponding to changing conditions of flow through the elbow, the graduated contacts are progressively immersed or withdrawn from the mercury, and the resistances connected between these nickel contacts are cut in or cut out from the electrical circuit. The resulting resistance, as automatically measured by the recording mechanism, is thus a measure of the float rise and hence of the pressure difference produced in the Hyperbolic Elbow by the fluid flowing through it. The bell float is kept in position by two vertical guide wires which pass through bushings in the flanges of the float. The bearing of these wires in their bushings gives a minimum friction. This is demonstrated by the fact that almost identically the same float rises are found to occur for increasing and decreasing pressure differences. A pressure shunt which short circuits any sudden pressure overload, and suitable moisture traps on the pressure connections, are provided outside the meter body.

The accuracy of the gas meter body is from 1% to 2% of actual reading between 15% and 100% of full load, and within 7% of actual reading between 5% and 15% load. It has 109 contact points. Where greater accuracy for this lower range, such as within 2% to 4% is required, a supplementary and more sensitive meter body is employed. The larger float of this supplementary body gives a greater rise under a small pressure difference than does the standard float, and permits a greater number of contact points

and hence a greater number of resistance units for the lower pressure difference range, with resulting greater sensitivity to smaller pressure differences.

The supplementary meter body is connected to the same source of pressure difference as the standard meter body, and is designed so as not to be disturbed by the larger pressure differences to which it becomes subject because of being connected in parallel with the standard meter body. The variable resistance of the supplementary meter body is connected in series with that of the standard meter body, and is the first resistance to affect the electrical circuit for the smaller pressure differences applied from the elbow. The total number of available contacts is thus increased above 109 by the number of additional contacts in the supplementary meter body. The accuracies secured by this combined meter body arrangement can be suited to almost any demand, and represent an accomplishment in gas measurement never before attained. This will be more fully appreciated, when it is stated, that, with this meter body, a contact movement of 2 inches is obtainable for a pressure difference of less than 1/8 inch of water!

The meter body for the measurement of steam, water, or oil is similar to that used for gas, except that the mercury well is increased in depth, the mercury being subjected to the action of the pressure difference, and that the pressure difference is transmitted through the insulating oil with which the meter body is completely filled instead of through a gas, as is the case of the gas meter body, which is filled with gas above the oil.

The withdrawal of the graduated nickel contacts from the mercury is thus effected by a combination of two things:

1. Rise of the float due to pressure difference acting upon the inside and the outside of the bell.

2. The fall of the mercury level due to the withdrawal of the float wall from it.

By reason of this combination of forces, contact rise above the mercury level may be made as high as 4 inches for full load, whereas the corresponding maximum pressure difference may only be between 1 inch and 3 inches of mercury. The maximum contact rise is kept constant at this high value for various meter capacities by varying the thickness of the float tube. The use of telescoping float tubes of different sizes furnishes an easy method of changing meter body capacity. Thus in one type of this general design of meter body, a contact movement of 3½ inches relative to mercury is obtained for a pressure difference of only ¼ inch of mercury.

The steam meter body is completely filled with insulating oil, and the pressure connections instead of going directly to the Hyperbolic Elbow, as is the case with the gas meter body, each connect first with an oil reservoir through a pressure shunt. An increase in pressure difference, as it raises the float, forces a portion of the oil out of the high pressure reservoir into the low pressure one, and vice versa.

In addition to the pressure shunts provided in connection with the oil reservoirs to care for sudden changes in pressure, the float wall sinks deeply enough into the mercury to protect against mercury blowouts up to an average of 250% of the meter capacity. The pressure shunt acts at 50% overload.

For measuring pressure differences in excess of 3 inches of mercury, the upward motion of the float is arrested by a limiting stop at a predetermined point, and subsequent increases of pressure act merely upon the mercury in a manner similar to a U-tube. The recording apparatus is then arranged to respond to the mercury movements accordingly. By this means the necessity for multiple meter bodies in the accurate measurement of heavy and widely fluctuating loads is avoided.

The accuracy of the meter body used for measuring flow of steam, water or oil is from 1% to 2% of actual reading between 15% and 100% full load, and within 4% of actual reading between 5% and 15% load. This type of meter body has over 120 contacts. It is chiefly the Logarithmic law of resistance variation that makes these unusual accuracies possible for such wide load ranges.

The electrical pressure gauge operates on the principle of a mercury manometer with one end closed. In the gauge chamber is a mercury well and a vertical bakelite tube closed at the top. Electrical contacts in the tube are joined by resistance elements which are made a part of the Wheatstone bridge circuit in the recording mechanism.

When the source of static pressure is connected with the gauge, the pressure is transmitted to the mercury in the well by means of the insulating oil with which the chamber is filled. This forces the mercury to rise in the vertical bakelite tube, compressing the air in the upper end of the tube until a balance in pressure is reached. The mercury movement varies the amount of resistance in circuit, and the variation is interpreted by the recording mechanism as a proportionate correction to the meter readings. The electrical contacts are so spaced as to give a pressure sensitivity corresponding to 1% of variation of density or specific volume.

A temperature coil placed in the chamber automatically corrects for variations in temperature of the entrapped air which otherwise would affect the correction for pressure variations.

The temperature plug makes use of the changes in resistance caused by changes in temperature.

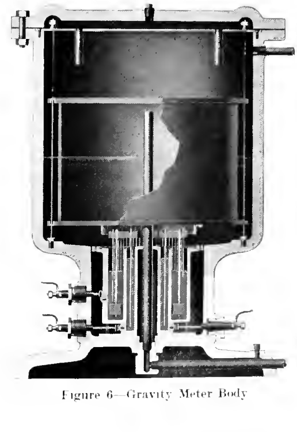


Figure 6—Gravity Meter Body

Elements of two materials with different resistance temperature coefficients are connected in series, and are so proportioned that the resultant resistance temperature coefficient gives the required correction when subjected to changes in temperature. The plug is held in a brass or monel metal tube screwed into the elbow measuring the flow, or into the adjoining pipe.

For correcting the readings of gas meters for variations in specific gravity, a column of gas is balanced against a corresponding column of air, and the resulting small difference in pressure is measured by means of one type of gas float meter body, which gives a contact rise above mercury level of 2 inches for 30% gas specific gravity, with correspondingly smaller rises for specific gravities ranging between 30% and 100%, as referred to air. The sensitivity of the gravity meter body, Fig. 6, as ordinarily furnished, is such that specific gravity changes of 1% are recorded, although when desired by a customer, the sensitivity can be increased to ½%. By the use of additional contacts and of extra electrical terminal plugs, a gravity meter body can be used both for automatic correction in gas flow metering, as well as for direct measurement of specific gravity by means of an extra electrical recorder. For corrective purposes, the resistance of the gravity meter body is introduced into the Logarithmic Wheatstone bridge circuit and is thus automatically and continuously applied as a correction for the final gas meter readings.

When specific gravity does not vary much in any one day, but varies from day to day, or during any other longer periods, a hand operated gravity rheostat may be substituted for the automatic gravity correction. This rheostat reads directly in terms of specific gravity. By the turning of a handle by means of a standard clock key, it may be set for any new specific gravity found from the tests. It can be located wherever most convenient for the person taking gravity readings.

Actual specific gravity graphic charts taken over a period of many weeks in a city using water gas, showed average daily specific gravity variations of 16%. These daily variations have on a number of days reached the 34% point, and have never reached below the 6% point. If such is the case for a definite manufactured gas, what variations are to be expected in the case of variable mixtures of coal and water gas, or in the case of coke oven, blast furnace or natural gas?

Since a 16% variation in gas specific gravity results in 8% meter error, it is of utmost importance to automatically correct for specific gravity variations. Only when a number of gas meters are located at the same station where a gravity meter is available, is it safe to use hand gravity rheostats, which may be set in accordance with recorded specific gravity.

Where a recording gravity meter is not available, it is possible to supply one automatic gravity meter body with as many as four independent terminal plugs, which may then be connected to four different electrical recorders. An example of such practice is found in the case of the Kansas City Gas Company. The natural gas supplied to the two Kansas Cities is metered at three distantly separted meter stations located at different city gates. One of these stations has four 12-inch, another has two 12-inch and the third one 12-inch and one 6-inch Hyperbo-Electric Flow Meters. Each of these stations is supplied with only one gravity meter body, but with four electrical terminal sets in the first station and with two electrical terminal sets in the other two stations.

The Kansas City Gas Company's installation is also a good example of the admirable suitability of the Hyperbo-Electric Flow Meters for long distance transmission. Each electrical recorder is supplied with a duplicate balancing rheostat, so that when the indicator pointer moves, two separate electrically insulated contact brushes slide over the two bakelite rings comprising the original and duplicate balancing rheostats. The resistance of the duplicate rheostat is then transmitted through two telephone wires to the main office of the company, located from 3½ to 6 miles from the various stations. These two telephone wires are then connected to the duplicate recorder located at the main office which measures automatically exactly the same resistance as the original recorder, a compensating resistance being provided to offset the resistance of the telephone wires

The Hyperbo-Electric Flow Meter thus represents a unique combination of highest accuracy with maximum ruggedness and flexibility in flow metering. It is the result of combining the best known improvements in every phase of the flow metering problem, any one of which would be sufficient to make this meter a distinct step in the progress of flow metering. It is the product of an unsatiable desire by its inventors to produce nothing short of a 100% flow meter, surpassing in ruggedness and accuracy even the common switchboard types of electrical instruments.

It is the only flow meter using a source of pressure difference characterized by a predeterminable flow coefficient independent of local piping conditions and constant for all ordinary load ranges. This in itself is an epoch making improvement in flow metering. It is the only flow meter which measures this pressure difference electrically by measuring *electrical resistance directly*, thus eliminating errors due to voltage variations. It is the only flow meter which uses any Wheatstone bridge in general and the Logarithmic Wheatstone bridge in particular for measuring the resistance changes caused by the variation of pressure difference with flow, thus making possible a flow meter accuracy based upon *actual meter readings* for loads ranging from 5% to 100% of maximum. It is the only flow meter where the automatic multiplying and dividing properties of the Logarithmic Wheatstone bridge make possible automatic correction for static pressure, temperature and specific gravity in flow metering. It is the only flow meter for which were actually developed such rugged, simple correcting devices as the electrical pressure gauge, the temperature correction plug and the specific gravity correction meter body. It is the only electrical flow meter, whose small current consumption makes long distance metering by use of telephone wires practical. It is the only flow meter characterized by an unusual flexibility of accuracy for lower loads, and by an electrical flexibility which leaves little to be desired in this phase of flow metering

As many an enthusiastic operating engineer has exclaimed: "It is the meter the engineering world

Continued on page 123

"THE SIGNIFICANCE OF THE FINE ARTS" A BOOK FOR EVERYONE

By

EARL H. REED, JR.,
Associate Professor of Architectural Design

HAVE you ever wondered how a life-size bronze statue was cast, or why such a work by a great sculptor is vastly more prized than any merely mechanical reproduction of a human body? Would you not be curious to learn from an authority that to-day's popular dance tunes hold in themselves the possibility of development into the great American art music of tomorrow? Would you know how parks and buildings and jewelry are designed, or how our great city plan, now being realized, was based on lessons of the past as well as needs of the present? Why were thirteenth-century Frenchmen so keenly enthusiastic over a cathedral building, just as we are over constructing factories? How is plate glass made? Is the worker in wrought iron an artist? How does our architecture compare with that of the ancients, and wherein lies the difference between architecture and mere building? All these very interesting questions and many others are answered and enlarged upon by a selected group of American authorities in a book called "The Significance of the Fine Arts," just published under the auspices of the American Institute of Architects.

Would you not wish to multiply indefinitely that thrill you felt run down your back when you first learned that wireless had been telephonized, the French six-plane had captured the speed record, or that the beautiful and glittering treasures of Pharaoh had been unearthed? How vastly more interesting life would be if an unusual building, a passage at the symphony, or an object of art in a friend's house could recall it at unexpected times! In very practical ways, too, more complete understanding of the fine arts can be of service, for we are constantly called upon in industry, in business, or at home, to distinguish between the good and useful and the ugly and cumbersome. Is it not consistent with our progressive American spirit, manifested in so many directions, that we should hasten to learn all there is to be known about architecture, sculpture, painting, industrial arts and music? Then America can record her greatness, and the life of each American be made richer. We remember Egypt by her pyramids, Rome by her arches, medieval France by her cathedrals, Renaissance Italy by her St. Peter's. What shall America leave to posterity? Let us awaken to the need of more expressive fine arts, and remove art from the dusty museum shelf to its rightful place around us in our daily lives!

The writer belives that no more promising step has been made in recent years in America toward furthering popular acquaintance with the fine arts than that represented by the present volume. It is intended for the general reader, and more particularly for use as a text book in connection with college courses in the fine arts. In fact, before the chapters were written, the idea received the endorsement of the Association of American Colleges, and definite plans are now being made toward the introduction of such courses into many American schools.

"The Significance of the Fine Arts" consists of an admirable introduction by George C. Nimmons, ten papers by eminent American authorities on architecture and on allied arts, and a fine epilogue by C. Howard Walker. Quite naturally, in view of the auspices of publication and the undoubted need of popular understanding due to past neglect, architecture in its various phases is dealt with in six of ten chapters. Paul P. Cret's splendid article on "Modern Architecture" is suggested as an excellent starting point for the general reader, in order that the others, relating to architecture of the past, which are perforce less vivid because of the subject matter, may be read from his inspiring viewpoint. "Classical Architecture" is presented by C. Howard Walker, "The Architecture of the Middle Ages" by Ralph Adams Cram, "The Renaissance" by H. Van Buren Magonigle, "Landscape Design" by F. L. Olmstead and "City Planning" by Edward H. Bennett. The last-named paper appropriately includes an enlightening review of zoning principles, a matter of especial interest to our city at the present moment.

The allied arts have been very interestingly written about by the following authorities: "Sculpture," Lorado Taft; "Painting," Bryson Burroughs; "Industrial Arts," Huger Elliott, and "Music," by Thomas Whitney Surette. The introduction calls attention to the book's freedom from technical language, its effort to explain the origin of art as arising from the needs and customs of people, and its use of anecdote and story. Vital principles of design and construction have been presented, as well as rules of good taste and refined judgment. Numerous well selected illustrations and an attractive make-up lend greater usefulness and beauty to this volume.

We may well be proud of the fact that four Chicagoans have taken an active part in its production: George C. Nimmons and Thomas E. Talmadge on the committee of publication, and Lorado Taft and Edward H. Bennett as authors of papers. Mr. Nimmons' introduction closes with the following finely written and comprehensive passage descriptive of the book's purpose, which fittingly concludes this review: "To call the attention of the public to the real importance of the arts is the great object to be attained. No matter what a man's station or calling may be, where he goes, or what he does, the products and activities of the fine arts confront him on every hand. From the cradle to the grave, the works of the fine arts are man's everyday companions, and it is in truth essential, if we are to appreciate and profit by God's blessings in nature and the best and finest works of man, that every member of the community should have some definite knowledge and appreciation of the fine arts."

"The Significance of the Fine Arts" Published under the direction of the Committee on Education of the American Institute of Architects, 1923. Marshall Jones Company, Boston, Mass. 8mo., 461 pages, illustrated. Price, $3.50.

ARMOUR TECH RADIO STATION, "9YL"

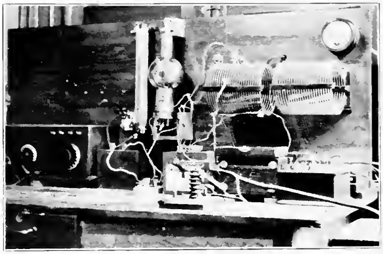
By

FRED MARCO, '24,
Vice-President, Armour Tech Radio Club

RADIO communication at Armour Tech previous to the fall of 1922 was more or less of a side-issue, due to the lack of time and proper equipment. However, a little more than six months ago a group of energetic and enthusiastic radio amateurs decided to see what could be done to put Armour on the map, as far as a radio station is concerned. Accordingly the Armour Tech Radio Club was reorganized with the opening of the school year. A personal advertising campaign was carried on, and speakers and interesting programs provided. This, together with the great interest aroused due to the broadcasting boom, more than doubled the membership of the Club.

Work on the station was immediately started with a view to finishing the more difficult outside work before the advent of cold weather. A preliminary survey of the apparatus and site proved disappointing. The Club was in possession, through the courtesy of the Physics Department, of a 250-watt power tube, a 50-watt tube, several smaller power tubes, a receiving set that wouldn't work, and a 1,500-volt—100-watt motor-generator of antique vintage. The site of the station was—and is— the second floor of the Physics Laboratory, in Chapin Hall. Plans for a more efficient antenna system were immediately drawn up, as it had been decided to shorten the then existing antenna and move it farther north, suspending it for the most part, between Chapin Hall and the Mission Building, and thus eliminating a large amount of dielectric loss. The old mast, a twenty-five-foot two-by-four, was used to support the south end of the aerial, the north end being held by a rope fastened to the topmost peak of the Mission Building, thus giving a span of about eighty feet. A two-inch cage, consisting of four wires equally spaced by large corks purloined from the Chemical Laboratory, was attached to the north end of the aerial, and led into the operating room. A heavy ground lead made up of a half a dozen strands of No. 12 weatherproof wire, securely soldered to everything in sight, was also installed. This completed the outside work, except for intermittent occasions when the high winds experienced during the past winter broke several of the main guy wires on the mast and allowed it to bend. Further trouble, however, was eliminated by increasing the size of the guys.

The installation of a simple and yet efficient continuous wave transmitter was the next problem. Partly due to the fact that the spark type of transmitting sets is fast becoming obsolete, and partly because of the power tubes the Club had available for experimental work, it was decided that only tube work would be carried on. Broadcasting of voice and music, as in done by others of the more prominent engineering colleges throughout the country, was temporarily eliminated from the program, inasmuch as the apparatus and the funds necessary for the maintenance of such a station were not at that time procurable.



Our 250 Watt Transmitting Set

After the apparatus had been hooked up for the preliminary tests it was found that the antenna current was far less than could be reasonably expected from the power supply. In the course of running down the trouble and correcting it many schemes were tried. The Hartley circuit, one of the simplest and yet most efficient of direct-coupled circuits, was first installed, but results were very disappointing. The antenna current obtained was only approximately one ampere, where at least three or four could be expected. Then in rapid succession, in an endeavor to trace the evil, the Colpitts, grid tickler, plate tickler, reversed feedback, and Meissner circuits were tried as well as several improvements and modifications of all of these. This seemed to do little or no good, however, and other methods of locating the trouble were tried. To make a long story short, it was found after many measurements had been taken, that the high frequency resistance of the antenna was nearly 200 ohms on the operating wave length! It was concluded that the fire escape, which runs parallel to the lead-in for its entire length, was the chief contributor to this inefficiency. Therefore, as a compromise, since neither the antenna nor the fire escape could be moved at that time, the ground was disconnected from the set, and the fire escape, in conjunction with a radial counterpoise strung between the two buildings, was connected in its stead. This proved a great improvement, the resistance coming down and the antenna current going up to about two and-a-half amperes on the 200 meter wave-length. The antenna insullation was then overhauled and improved wherever possible by the installation of new insulators in some places, and by clean-

ing the soot and dirt off others. The ground was improved, and finally, after returning to the Hartley circuit, slightly bettered by the elimination of several leaky condensers, the radiation current was brought up to three amperes on the 50-watt tube and between four and five amperes on the 250-watt tube.

Then "Old Man Trouble" came along, and all but wiped out the place! In the space of two days the 50-watt tube burned out, the motor generator blew up, and the receiving set quit working! However, due to the hearty co-operation of Professor Wilcox, the generator was repaired and the 250-watt tube permanently installed. After the receiving set had been torn down and thoroughly overhauled and a temporary arrangement of honeycomb coils set up, the station was once more in operation.

A general idea of the layout of the apparatus during the preliminary experimenting can be gained from the accompanying picture of the interior of the station, taken during the first few days of work. The transmitting set is on the right and the receiving set on the left. This receiver was of the three-circuit regenerative type, with two variometers and a variocoupler, arranged with one step of audio-frequency amplification. It has recently been replaced with the much more beautiful and efficient piece of apparatus described in the following paragraph. To the right of the receiver can be seen the 250-watt tube with the filament rheostat and switch, the two tuning inductances which allow waves between 150 and 800 meters, filter and by-pass condensers, together with several meters for plate and filament control. The antenna switch and radiation ammeter can be seen to the right. At the lower right hand corner is a large filter condenser, used to smooth out the hum from the commutator of the generator. This does much to eliminate interference with local broadcast listeners.

In the second photograph can be seen the new receiving set with which the Club has recently been presented due to the kindness and foresight of Mr. R. H. G. Mathews of the Chicago Radio Laboratories. Mr. Mathews is a former Armour Tech student. On the occasion of a recent visit to talk before the members of the Club he very kindly offered to donate to the Club the "Zenith Multiceiver," a product of his own firm. This set was used at experimental station 9ZN throughout the past winter, figuring prominently in most of the long distance communication for which that station has been noted. It is expected that with its aid Armour Tech Station 9YL will be able to duplicate that work in at least a small measure. This set is of the familiar Armstrong regenerative type, incorporating detector and three stages of audio-frequency amplification all in one unit, thus making a very complete and compact layout. Referring to the second photograph, the lower three dials are the main tuning controls, the left and right being the grid and plate variometers respectively, and the center the coupling variation. The lower left hand switch, in conjunction with the variable condenser in the center of the panel, tunes the primary or aerial circuit to the desired wave length. The small switch to the right is a long-and-short wave arrangement, permitting two ranges of wave lengths to be covered with the same controls. The meters are in the filament and plate circuits of the tubes, which are controlled by the four rheostats in the upper row. The two dials at the right are the grid condenser and potentiometer for adjustment of the detector tube to maximum sensitivity. A small switch is provided for controlling the filaments of the tubes, so that the rheostats, once adjusted, do not have to be turned off when closing down the set. Phone jacks on the front and binding posts on the back of the panel, provide means of connecting to external circuits. The set has proved very efficient in operation. During preliminary tests immediately before presenting it to the Club, several Pacific Coast broadcasting stations were tuned in with surprising audibility.

The "Zenith Multiciever"

In transmitting, considering conditions, the range of the 250-watt set has proved exceptional. Power is not available for use after midnight, and as amateur relay work does not start before 10:30 P. M., due to interference with broadcast listeners, the time for operation is exceedingly short and must be used to maximum advantage. Stations within a radius of 500 miles have been worked at night with comparative ease, reports of 9YL's signals having been received from several times that distance. An operating schedule is maintained four nights a week, and many messages relayed. During the daytime when operators have free hours, transmission is carried on with stations in the neighboring states or broadcast programs listened to.

A new program of events is scheduled for the fall term opening. The Club has plans for a tall mast to be located in the open space back of the Mission and Chapin Hall. It also hopes for new and more exten-

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ALUMNI

Associate Professor James C. Peebles, *Editor*

Dr. H. W. Nichols

THE most revolutionary progress to be made in radio telephone history has been participated in by Dr. H. W. Nichols, '08, E. E., '11, who served as a member of the Faculty of the Armour Institute of Technology from 1910-14.

Dr. Nichols has been instrumental in the design of the first radio telephone which has been able to communicate directly from New York to London. At this time only meager information is obtainable because Dr. Nichols is as yet in London but it can be said that nothing has so impressed the English engineers as the accomplishment of this epochal step in radio science. A distinguished group of listeners heard the first words to be sent across the Atlantic in the new Southgate factory of the Western Electric Company near London and the test was declared an immense success.

As our Alumni Association increases in membership, and our members grow in experience and ability, many of them have reached positions where they are employers of engineers, or are called upon to select employees for the firms with which they are connected. It has been a source of gratification to all concerned to note how frequently the old "grads" come back to the Institute, or write to someone there when in need of the services of a young engineer. This is the kind of co-operation which we are all anxious to promote among Armour men. "Hire an Armour man" is an excellent motto for the elder alumnus, for by so doing he will serve the best interests of the Institute, give the young graduate an opportunity to get started in the profession, and secure for himself an employee who would rather work for an Armour man than anyone else, and so is anxious to make good.

W. F. Parker, '05, was a caller at the Institute on March 22. He is now sales manager for the Packard Electric Company of Warren, Ohio. His firm manufactures and sells a complete line of transformers, and also a somewhat specialized line of electric cables for use in automobiles. Mr. Parker reports that business in his line is good, and that prospects are excellent for increased business in the future. He is looking for two young men to start out in the sales department, with the idea of developing them into sales engineers. Being a loyal alumnus of Armour, Mr. Parker wants two Armour men, and spent a considerable portion of the day in interviewing several members of this year's graduating class. It is quite possible that one or more of them will start in with the Packard Electric Company after graduation, because Mr. Parker kept the alumni motto in mind.

If the records are to be relied upon, Parker was the only student prior to 1905 who ever secured seven A's in a single term; and yet no one who was a student in those days will say that he was a grind. In his Junior Year, '04, he had four A's in athletics and three in social activities. His specialties were baseball pitcher and dance manager. For three years he was the mainstay of the "Tech" team, his work in the pitcher's box being responsible for many victories. Frequently, after a hard game on the diamond, he would be found in the evening at Rosalie Hall or the Unity Club House, the moving spirit in some Armour social function.

In view of the fact that student activities outside the classroom are often criticised, and efforts made to place strict limitations upon them, it is a pleasure to record the practical success in later life of one who was a leader in such activities. Some of the professors had serious doubts about Parker as an engineer, but he has made a good one, and we believe that an agreeable personality and ability as a "mixer," developed in student activities outside the classroom, have contributed in no small measure to his success.

M. A. Smith, '10, is director of education for the United States Gypsum Company, Chicago. In this position he engages and trains the salesmen and sales engineers who are employed by the company. From time to time during the past ten years he has employed quite a number of Armour men, and they must have proved satisfactory, for he is looking for more from the present class. Several of the Seniors have been to see Mr. Smith, and it is confidently hoped that he will find among them the material for which he is looking.

Incidentally, our Association needs more men like M. A. Smith. He has been active in all alumni affairs, attends the semi-monthly luncheons whenever business will permit, and never loses an opportunity to boost the Alumni Association and the Institute.

Prof. E. S. Libby

"Do you remember 'way back when" E. S. Libby, '02, looked like the picture which we reproduce on this page? Do you also remember that annual occasion, now forgotten by many, the Faculty-Senior Baseball Game? In the game of 1902, Libby played second base for the Seniors. About the middle of the game, while running out a hit that looked like a home-run, he slipped an eccentric and stopped on dead center at third base. Emergency repairs were made and he was able to finish the game, but under reduced pressure.

In subsequent years, as a member of the faculty, Mr. Libby has taken part in many of these annual games. On such occasions he was always the recipient of voluminous advice from his students in the bleachers, who insisted on considering the game an experiment in steam engineering, with the positions of professor and student reversed. "Sand the track," "put 'er in reverse," "full steam ahead," and similar items of advice were heard from all over the field, while Libby made a mental note to give an examination on the Zenner diagram the next day.

L. I Goldberg, '17, has succeeded in getting into business for himself in much shorter time than is usual for the young man from college who aspires to that degree of business independence. While he was still an undergraduate in Civil Engineering at the Institute, Mr. Goldberg spent two summers in the Illinois State Highway Department on paving, bridge building, and general highway work. After graduation he continued in the same work for a year, and then transferred to the Highway Department of the State of Michigan. Here he spent two years almost exclusively on paving work, on the hard roads system of the state.

Mr. Goldberg finally decided, however, that the future as a highway engineer on state roads was not sufficiently attractive to warrant his staying in it. He accordingly decided to go into business as a paving contractor; work which he knew intimately from his highway experience. He got together all the money he could, bought a paving outfit, and set out in business in Traverse City. He has been fortunate in securing several state contracts, and from the beginning has had practically all the work he could do. It takes courage and self-confidence to quit a job with an assured income and start out in one's own business, and we congratulate Mr. Goldberg on his success.

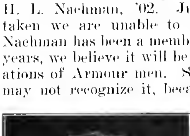
J. A. M. Robinson, '11, was renewing old acquaintances at the Institute on April 2. For some time past Mr. Robinson has been Assistant Manager and Engineer with the American Well Works, Chicago. In this work he has had an extensive experience in problems of municipal water supply, land reclamation projects, and the like. At the same time, he has devoted a portion of his time to a general engineering practice along the line of developing, standardizing, and supervising industrial and manufacturing processes. He has recently found it necessary, on account of the growth of his business, to devote his entire time to a consulting practice along this latter line. Many industrial and manufacturing concerns do not have an engineer on their regular staff, but are frequently in need of engineering services. In improving old methods and developing new, devising and installing new equipment, and properly correlating all the work of the plant, the engineer finds a fruitful field for effort. It is along this line that Mr. Robinson expects to devote his entire time, as a consulting engineer.

W. S. Pawlowski, '21, called at the Institute a few days ago in the uniform of the U. S. Regular Army. He enlisted almost immediately after his graduation; was assigned to the Aviation Service and stationed at Chanute Field, Rantoul, Illinois. Later he was transferred to Bolling Field, Washington, D. C., where he is located at the present time. He came from Washington to Chicago by airplane in about nine hours flying time, with two stops.

Pawlowski expects to return to Chicago when his term of enlistment expires. He has a Curtis plane of his own and will bring it back with him, with the idea of seeking an opening in commercial aviation. He has promised to take some of the professors for a ride, but a few of them didn't seem very keen about it. Perhaps one or more of the latter may have sent Pawlowski a flunk notice during his student days. In any event, it looks like more business for Harry Coffeen

Prof. C. W. Leigh's long legs proved a real advantage in the faculty race held on Circus Day. It was generally conceded before the match that considerable advantage lay with Prof. Leigh. He received a magnificent cup as a trophy.

We are also able to present an early photograph of H. L. Nachman, '02. Just when this picture was taken we are unable to say, but inasmuch as Mr. Nachman has been a member of the faculty for several years, we believe it will be recognized by many generations of Armour men. Some of the later graduates may not recognize it, because the subject has grown much stouter than when this picture was taken, his weight having increased 23.5 grams in the last ten years.



Prof. H. L. Nachman

Mr. Nachman now devotes practically all of his time to the teaching of thermodynamics. This is one of the heavy subjects in the course at Armour, a subject that is carried by some students and dragged by others. The draggers have found Professor Nachman a patient and painstaking teacher. He can listen to a definition of adiabatic expansion as "one in which the volume remains constant," without losing his composure.

COLLEGE NOTES

THE annual Traveling Scholarship of the Architectural Club for $1,000.00 which requires six months of travel in Europe in the study of Architecture was won by R. J. Nedved of the Class of '21. The subject of this competition was a Neighborhood Centre of Fine Arts. The Jury was composed of well known Chicago architects. The problem involved unusual difficulties because of the triangular site given.

At the assembly of May 3, 1923, Raymond O. Matson, '23, formerly Sergeant, Company C, 123d Machine Gun Battalion, 33d Division, was officially notified by Colonel Manus McCloskey, Assistant Chief of Staff of the Sixth Corps Area, that he had been awarded the Distinguished Service Cross for bravery in action. The Citation reads: ..."For extraordinary heroism in action at Marcheville, France, November 10, 1918. Voluntarily leaving the shelter of the trenches and exposed to a terrific enemy machine-gun and artillery fire and under direct observation of the enemy he rescued three wounded men, assisting them to a place of comparative safety. The outstanding bravery and soldierly devotion to duty displayed greatly encouraged the men of his company."

Dean M. E. Cooley of the University of Michigan will deliver the Commencement address at Armour Tech on May 31. Dean Cooley is one of the most prominent engineers and educators in America. He has recently succeeded Herbert Hoover as President of the Federated American Engineering Societies, and as chairman of the executive council of that body. He is also Past President of the A. S. M. E., and of the S. P. E E., and has held numerous other prominent positions in the engineering and the educational world. The Seniors may well congratulate themselves upon having such a prominent man and great engineer present at their Commencement exercises.

"Open House" has by its second phenomenal success proved its right to a permanent place in the Armour Tech calendar. Upon going to press official returns have not been received, but it is estimated that upward to two thousand persons were present during the evening. Shops and laboratories were open and in operation, with student volunteers "showing off" just as they did at Open House last year. As an addition to last year's program the Fire Protects staged a five-reel movie, with highly approved pictures and film, and Professor Wilcox and his radio fans provided an excellent radio concert. The "feminine element" seemed quite in evidence, especially in the Gym, where Bill Blaufas and his associates held forth.

On May 16 the first Athletic Association Banquet will be held at the University Club. As toastmaster for the occasion Mr. John J. Schommer has been chosen. Athletic Directors Alonzo Stagg of Chicago, and Knute Rocne of Notre Dame have been invited to be present and help make the affair a successful

Continued on page 124

SCHOLASTIC STANDINGS

The following statistics, compiled by the office of the deans, give the scholastic standings of the members of the Freshman, Sophomore, Junior, and Senior Classes of the College of Engineering and Architecture, who were in attendance during the first semester of the school year 1922-23. In this computation the grades in physical training were omitted. A credit, either for work at the Armour Institute of Technology or for work elsewhere, was considered equivalent to a grade of "B."

The average of the entire school body, a total of 694 students, is 85.54 per cent.

The averages of the various organizations are as follows:

The Senior Class	88.41 per cent
The Junior Class	87.02 per cent
The Sophomore Class	85.02 per cent
The Freshman Class	82.93 per cent
Mechanical Engineering Department	86.4 per cent
Electrical Engineering Repartment	85.2 per cent
Civil Engineering Department	85.1 per cent
Chemical Engineering Department	86.7 per cent
Fire Protection Engineering Department	86.0 per cent
Architectural Department	82.1 per cent
Industrial Arts Department	92.1 per cent
The Honorary Fraternities:	
Tau Beta Pi	91.6 per cent
Scarab	86.7 per cent
Eta Kappa Nu	90.4 per cent
Phi Lambda Upsilon	91.6 per cent
Salamander	90.6 per cent
Chi Epsilon	90.4 per cent
Social Fraternities and Clubs:	
Phi Kappa Sigma	85.4 per cent
Delta Tau Delta	84.4 per cent
Theta Xi	85.1 per cent
Sigma Kappa Delta	84.8 per cent
Beta Phi	84.6 per cent
Sigma Alpha Mu	87.7 per cent
Rho Delta Rho	86.7 per cent
Tau Delta Phi (The Pyramid)	86.5 per cent
Scroll and Triangle	86.6 per cent

The average of all students belonging to the Phi Kappa Sigma, Delta Tau Delta, Theta Xi, Sigma Kappa Delta, Beta Phi, Sigma Alpha Mu, and Scroll and Triangle is 85.56 per cent.

The average of all other students is 85.53 per cent.

In the above, the following numerical values were given to the letter grades: A=97.5 per cent; B=90 per cent; C=80 per cent; D=67.5 per cent; E=50 per cent.

REGISTRATION SECOND SEMESTER, 1922-1923

	Seniors	Juniors	Sophomores	Freshmen	Special	Total
Mechanicals	48	38	36	45	..	167
Electricals	25	40	48	51	..	164
Civils	28	32	18	28	1	107
Chemicals	12	26	23	18	..	79
Fire Protects	5	24	26	20	..	75
Architects	9	14	16	28	2	69
Industrial Arts	..	1	..	..	..	1
Total	127	175	167	190	3	662

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EDITORIALS

AU REVOIR, MES AMIS, AU REVOIR

Goodbye, my friends, Goodbye!

With the publication of the May issue of the Armour Engineer the staff for the college year 1922 to 1923 concludes its duties and the Editor is pleased to announce that the Executive Council has appointed Elihu Orson Pierce to the position of Editor and J. Stanley Farrell to the office of Business Manager.

In viewing retrospectively the pleasures and trials alike which have attended the work of the year just ending we are moved to an expression of the gratitude and appreciation which we feel toward those gentlemen of the faculty who have so helpfully assisted us.

For what of worth and dignity the Engineer could boast of in its conception, credit is due to President Raymond; and to Dean Monin who has been our father in all other things of our college life we attribute the inspiration which has made it possible to visualize the ideal to be attained and then to keep that ideal ever in mind. The conversations which took place in his office before each successive issue, served to mold a sound and conservative policy for the Engineer, and the staff has been left with a picture of wisdom, justice, and friendliness that of itself is the finest recollection we have of our service with the Armour Engineer.

Nothing which we might have done would have sufficed if Professor Campbell had not suggested the cover designs which were commensurate with the standard to be set and purpose to be served. It will be recalled that the finest number of the year was that which was almost wholly compiled by Professor Campbell; the "Architectural Number." He has repeatedly advised us in matters pertaining to the mechanical arrangement of the magazine and has been its constant guide to more pleasing and artistic effects.

Professor Peebles has not only acted as "Alumni Editor" in a most satisfactory way but he has been of good counsel as well and deserves our kindest appreciation for his services.

Many former Armour men will be very sorry to hear of the death of Mr. James Little, which occurred early Saturday morning, April 28th. For many years Mr. Little was superintendent of buildings for the Mission and Institute, and was a familiar figure about the premises. He had failed rapidly in health during the past year, but the end came suddenly and was a distinct shock to his many friends at the Institute. He was a sterling Scotch character, respected and admired by all who knew him. His death marks the passing of another familiar landmark in the history of the Institute.

A PROPOSED RECLASSIFICATION OF ENGINEERING COURSES

The *Wisconsin Engineer* for January, 1923, contains a reprint of part of a paper prepared for Tau Beta Pi upon this interesting subject. The plan discussed is based upon the recent suggestion of Professor Bennett of the University of Wisconsin, that the customary classification of engineering courses be changed to the following:

Course in Engineering Research.
Course in Engineering Design.
Course in Operating Engineering.
Course in Maintenance Engineering.
Course in Construction Engineering.
Course in Sales Engineering.

This plan has evidently been evolved with a view to effecting a closer relationship between engineering courses and the educational needs of a practicing engineer; also with the idea of including in the engineering curriculum certain subjects which have long felt to be needed, and of excluding others which are at present more or less unnecessary except to a special few. As such, the suggestion is a valuable one and should be given due consideration. It may become the basis for much desirable progress in the science and art of engineering education.

However, Professor Bennett has as yet given out no details in connection with this new scheme, and a discussion of such a subject without a knowledge of the details, would of necessity be purely speculation. A specific engineering course is the same course by whatever name it may be known. And as long as good mechanical engineers insist upon becoming salesmen, and good salesmen mechanical engineers, a high state of correlation between education and future activity will remain impossible.

A UNION OF ENGINEERING SOCIETIES

During the fall, rumors upon the U. of I. campus had it that a movement was on foot to abolish the various departmental societies and to establish in their stead a single engineering society, says the *Technograph*. The plan favored the American Association of Engineers as the nucleus of this single large society. The *Technograph* comments both favorably and unfavorably upon such a plan, but concludes that the greatest possible good at present, would come from a closer union of the present societies.

Continued on page 124

O. M. Spaid, *Editor*

The Track Team, 1922-1923

TRACK

On April 28th Coach Phalen took his men to Naperville to meet Northwestern College. About twenty men were taken as it was the first meet of the year and the class of material was very uncertain. It was thought that Armour would lose in the field events and the distance men were counted on as being our heaviest point winners. However, the dope bucket was turned completely over as our distance men went stale and were no match for the Northwestern men who took all places in the half mile, mile, and two mile. In the field events Colby took first in the pole vault; Hammer, third in the shot put and broad jumps; and Pate and Hammer easily out-classed any Northwestern high jumpers. In the 440 yd. run Owens and Blair landed in second and third respectively. Perry and Spaid had little competition in the hurdles and the century went to Spaid by a bare two feet. The final points were: Armour 46; Northwestern 67.

On the morning of May 4th the team meets Augustana College and on May 19th a quadrangular meet with Northwestern, Beloit and Lake Forest will be held at Lake Forest.

WRESTLING

Due to a late start and the inexperience of most of the men, the wrestling season has ended with but only one meet. This was with the American College of Physical Education and was easily won by Armour. There was also a very interesting inter-class meet which was won by the Freshmen with the Sophomores, Juniors, and Seniors next in line.

Some of the men who have showed up favorably and who should be strong point winners are McHenry, Janak, McLaren, and Gymer. Heller and Day will, no doubt, prove to be hard men to toss around. Stangel, one of the best men on this year's team, is graduating and so leaves an opening in the 125 pound class.

In turning out his first crew at Armour, Coach Smith has demonstrated his ability as a coach and with this year's squad practically intact, the outlook for next winter is quite optimistic.

BASEBALL

For the third consecutive year the baseball season opened at Armour with Lee Walsh as coach. Few new men appeared permanently in the line-up, Downes at second base and Schonne in center field being the only two changes while Ruzich and Eppich were added to the pitching staff. Cole was injured early in the season and has had to give up his position at short stop. The games played to date and the scores are:

Univ. of Wisconsin, 13—Armour Tech., 7.
Bradley Tech., 10—Armour Tech., 3
Augustana College, 2—Armour Tech., 6.
Lake Forest Univ., 8—Armour Tech., 8.
Univ. of Toledo, 5—Armour Tech., 11.
De Kalb, 10—Armour Tech., 12
Chicago, 8—Armour Tech., 4.

SOCIETIES

R. M. BECKWITH, *Editor*

TAU BETA PI

THE Tau Beta Pi annual spring banquet was held at the City Club on Friday, March 2, 1923, and was well attended by about one hundred members of the "Old Guard." At the speakers' table were Mr. John W. Lane, Toastmaster; Dr. A. E. Phillips, Mr. Frank D. Chase, Mr. Edward H. Evers, Mr. E. T. Hanson, and Mr. Bruce Amsbary, all of whom afforded a most interesting and entertaining program.

The following juniors were pledged Tau Beta Pi on April 4, 1923:

R. M. BECKWITH	C. F. KAUTZ
E. J. BENSON	T. E. MCDOWELL
R. B. BERRY	E. O. PIERCE
M. G. BURKEY	R. J. RASMUSSEN
H. J. GOODMANSON	J. H. SWEENEY

SCARAB

Ho! Hum! Spring has been trying hard to get in her deadly work. Wish we had time for a real spring yawn.

The Scarab national convention, held in Chicago at the Auditorium Hotel on April 6 and 7, was a most successful affair. It was socially enhanced by a theater party and a banquet. At the same time the Scarab traveling sketch exhibition, which has met with universal acclaim, and the Scarab national competition drawings were exhibited.

Edfou extends congratulations to I. Jerry Loebl in placing first in the second preliminary for the Paris prize; and also to George Connor for placing first in the entrance examinations in design at the Beaux Arts, in Paris.

The national organization is planning to offer a prize for some Beaux Arts project, the nature of which has not been decided.

It's nearly time to go out and get a summer job. Guess we'll finish that yawn. Ho! Hum!

ETA KAPPA NU

The following men of the Junior electrical class are now pledged to Delta Chapter:

JOHN O. AALBERG
J. STANLEY FARRELL
L. LOREN SWARTZ

These men entertained this chapter and the alumni chapter at the semi-annual inquisition banquet held on April 24, and demonstrated that they were future Edisons.

The annual Eta Kappa Nu convention was held at Madison, Wis., on April 6 and 7. Lester E. Grube represented Delta Chapter on that occasion.

The brothers have been getting out the old ball and glove pretty regularly. Warning is hereby given to the other honoraries that they had better do the same.

PHI LAMBDA UPSILON

Phi Lambda Upsilon is nearing the close of a very busy and successful year. The fraternity has been responsible for obtaining many unusually good men to address the bi-monthly meetings of the Armour Branch of A. I. Ch. E. Herein we feel that Phi Lambda Upsilon is fulfilling one of its big obligations —that of bringing the views and experiences of outsiders to the attention of the student "Chemicals."

Our calendar:

First Pledge Smoker—November 1, 1922.
First Initiation—February 10, 1923
First Banquet—February 10, 1923.
Second Pledge Smoker—March 20, 1923.

Our spring initiation will be held before Junior Week. The initiates of the fall were: Francis Blumenthal and Morris Cohen. The present pledges are: Kautz, Huseman, and Brady.

SALAMANDER

Salamander, Fire Protection Honorary Fraternity, announces the pledging of the following men:

A. T. WATERMAN, '24
E. O. PIERCE, '24
E. SESTAK, '24
E. N. HARSHA, '24
E. E. MCLAREN, '24

CHI EPSILON

The Beta Chapter of Illinois of Chi Epsilon was installed at Armour Tech on Mach 29. Chi Epsilon is an honorary civil engineering fraternity, basing the selection of its members upon scholarship, sociability, and practicability. The installation took place at the Scroll and Triangle Fraternity House under the direction of the Alpha Chapter of Illinois, University of Illinois. The organization at this time includes:

Honorary Member

PROFESSOR A. E. PHILLIPS

Seniors

C. W. CARLSON	F. A. HESS
E. F. DE BRA	R. S. MAYO
F. G. FREDERICKS	H. W. MUNDAY
C. S. FRINK	C. M. MYERS
G. GOEDHART	O. G. SMITH

E. W. PRENTISS

Juniors

M. G. BURKEY	J. H. LINDER
R. B. BERRY	F. R. NELLE
L. R. QUAYLE	R. J. RASMUSSEN

J. H. SWEENEY

A smoker was held on April 25th at the Scroll and Triangle house. Mr. H. E. Roulfs, nationally known character analyst, gave a very interesting talk on character analysis, and demonstrated his theories by analyzing several of the members present. On May

18 the first annual banquet will be held. Several of the Civil alumni will be guests, and a surprise program has been arranged.

SIGMA KAPPA DELTA

Sigma Kappa Delta announces the initiation, on April 14, 1923, of the following men: W. R. Lee, S. A. Baird, L. R. Hoff, C. E. Tweedle, and J. R. Frederick. After the initiation, the new brothers were guests at the annual banquet, held in the Fraternity Room of the Great Northern Hotel. Guy F. Wetzel was toastmaster, and many of the alumni were there. Among them, Edwards, Seaberg, Vaaler, Judson, Rosback, S. H. Smith, S. N. Peterson, Michel, R. G. Coles, Herbst, M. F. Bacon, and our faculty members, C. W. Leigh and J. C. Peebles.

J. H. Watt is on a steel construction job with the McClintic Marshall Co., at Steubenville, Ohio.

C. A. Herbst is in the chemical department of the Economy Fuse Co.

J. C. Vaaler is with the engineering sales department of the Celite Products Co.

M. F. Bacon, who is with the Anylite Electric Co., Fort Wayne, Ind., came up to help us out on the initiation.

DELTA TAU DELTA

Everyone in the house is bearing down on his work now, in preparation for the "finals" in May. We hope to gain the coveted top position in the scholarship list, which we held not long ago.

Much to our sorrow, we were eliminated in the inter-fraternity basketball tournament in our first game; Beta Phi were our opponents. It was a fast, flashy game all the way through, and Brothers Rudishauser, Greenleaf, and McClaren are to be highly commended. We are expecting great things from Joe and Jack in the future.

Circus day is now the big item to us, and everyone is earnestly working to "cop off" the honors in both the track events and in the pageant.

At the close of this year Delta Tau Delta lose five good men and true. Brothers Cox, Lizars, Nutt, Rudishauser, and Stantial will leave Armour Tech for a great future. It will be hard to fill their places as "actives," and the chapter will feel the loss.

Once more we want to extend an invitation to all Delts in and about "Chi," and all alumni of our chapter, to attend our Anniversary Celebration on May 10.

SIGMA ALPHA MU

In March, 1923, Sigma Epsilon Chapter, Sigma Alpha Mu, initiated five men: N. B. Schreiber, L. J. Blume, W. Kaufman, M. Herman, and I. H. Cohen.

Our activities since the first of the year have included a house party, two smokers, an initiation banquet, and an alumni dinner. We are all looking forward with anticipation to our annual spring dinner-dance, to take place on May 12.

We are soon to lose by graduation Sang, Goldstein, Stangle, Pollan, and Rothberg. We wish them all good fortune in the years to come.

SCROLL AND TRIANGLE

The "pep" at our house has been somewhat of a relief from the eternal grind. On March 31 we enjoyed a dinner-dance; and an informal was held on April 21. Following the Glee Club concert, April 23, open house was observed.

May 9 is the date set for our faculty smoker, "Parents' Day" following on May 20. We feel that our year has been a very successful one.

PHI KAPPA SIGMA

A new "order of things" has been instituted at the Phi Kappa Sigma House; a sophomore has been appointed to act as a "fraternity father" for each freshman; a junior for each sophomore; and a senior for each junior. The duty of these "frat fathers" is to check up on the scholastic standing of their "sons," and to try to keep them on the right track. It is hoped that this plan will be beneficial to all concerned.

On April 21, we held our semi-annual alumni smoker, and a goodly number of alumni were present.

The lower classmen have decided to give a party in honor of the seniors on April 28. The details of this party have been withheld from the seniors.

May 13 is the date that has been set for "Parents' Day"; on this date we will entertain our folks at the house.

BETA PHI

This is a season of great excitement about the house; preparation for coming events, yellow dog initiations, and general activities are keeping the enthusiasm above par.

Pledges Graustra, Pronger, Murray, Marhoefer, De Haan, Fairbanks, Conley, and Lowden, are being trained by an unusual participation in fraternity affairs.

A Junior Week Alumni Smoker is being planned. The date set for it is May 3.

THETA XI

It sounds rather queer to hear one say that a fraternity house was besieged by fair damsels, but nothing else will express what happened at the Theta Xi "mansion" a few Sundays past. Eighteen of them, the fairest lot we'd seen for many a day, arrived about three o'clock, laden with cakes, sandwiches and what not—even chaperones. Several of the brothers who came in shortly before midnight verified the assertions that Evanston was "home."

Over seventy "Fire Prevents" were present at the first smoker in the history of the Armour Fire Protection Engineering Society, held at the house on March 29. The affair was a marked success, and Theta Xi appreciates the opportunity of opening its house to the men of this department.

The Annual Faculty Smoker held sway on the "one-lucky" evening of Friday, April 13. Over thirty of the faculty cast aside any superstitions they may have had, and gathered for what we hope proved to be an evening of genuine enjoyment.

On April 7 Richard N. Mann, '18, of the old guard of Omega Lambda, was initiated into Theta Xi, and on April 25, J. Stanley Farrell, Charles D. Johnson, and George E. Woodfield, all undergraduates, were taken into the bonds.

The complete list of those present at the Annual 6294 celebration on April 27 is not available at the time this goes to press, but among the hundred or more brothers assembled to celebrate our birthday, all but one chapter was represented—a record of which we are justly proud.

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DEPARTMENT NOTES

MERLE C. NUTT, *Editor*

THE College is fortunate in that a number of the members of its faculty have prepared during the last year, or are now in the course of preparing, text books or scientific papers for use of colleges of engineering.

It is difficult to overestimate the significance of this work because it not only goes far toward establishing the prestige of The Armour Institute of Technology in the engineering world, but it assures the college of an active, alert, and energetic faculty, to say nothing of insuring the student something more than the pedantry of the pure theorist.

A case in point is that of the text book, "Steam Power Plant Engineering," by Mr. George Gebhardt, Professor of Mechanical Engineering; this book is not only a recognized standard throughout the scientific schools of the United States, but it has been the guide of the operating engineer as well and has as a consequence served as an introduction for every Armour Graduate in the engineering profession. The compilation of such a work brings before its author a most comprehensive view of the latest developments of a broad and ever changing field and his value as an instructor is accordingly enhanced. It must be understood too, that the composing of a text book is a difficult and tedious undertaking and is not nearly so lucrative as the consulting practice which must be forsaken in its stead. Every encouragement is due to those members of the faculty who have been so active in their respective departments; they have done much to elevate the standing of our Alma Mater.

From time to time a large amount of work of an experimental or research character is done in the various departments of the Institute. Concerning this work very little is ordinarily known outside of the Department in which the work is actually conducted. This is indeed unfortunate, for much of the work is of an interesting nature as well as of considerable industrial importance.

At the present time Professor Gebhardt and Mr. Davies are directing work in the Mechanical Engineering Department, upon the subject of the use of the steam jet as a means of producing mechanical draught. Up to the present time such an application of the steam jet has proved inefficient. However, it is the contention of Professor Gebhardt that by proper design of these jets, and their correct placement within the stack, this difficulty may be overcome.

In the same department three Seniors are at work upon a positive action rotary compressor for use with refrigerating apparatus. In these tests ethyl chloride is being used as the cooling medium.

Professor McCormack, head of the Chemical Engineering Department, has recently been occupied with a large amount of research and experimental work. At present he is working upon the problem of substituting ammonium sulphate for sulphuric acid in the manufacture of the alums. The problem is a big one since it is necessary to determine whether or not the substitution will be advantageous from many standpoints, namely: purity of product, relative solubility of iron in the two processes, and the recovery of ammonia as ammonia and ammonium sulphate.

Mr. Nelson of the Fire Protection Engineering faculty is now working on a new book which is soon to go to press. This book, the "Fire Underwriters' Handbook" is to contain a hundred or more illustrations, drawn in perspective, illustrating standard building construction and standard methods of installation for various protective appliances. The book will also contain concise explanations of the standard specifications to which the illustrations refer.

The illustrations for this work are being prepared by Mr. Lesser, Department of Mechanical Engineering, and O. L. Cox, '23, and Blair, '23.

A. I. T. has recently become the possessor of the personal metallurgical library of Dr. H. O. Hofman, Professor of Metallurgy at the Massachusetts Institute of Technology. This collection is particularly invaluable, including as it does many original metallurgical texts, some of which are written in French, German and Russian, together with many of Dr. Hofman's personal notes upon various metallurgical questions.

THE FLOW OF FLUIDS

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has been waiting for!" The waiting period is now over. The dreamed for flow meter is here at last to stay, and any part of it is flexible enough to be combined with other less accurate metering devices. Thus, the Hyperbolic Elbow may be combined with any pressure difference measuring device. The electrical meter body may be used to measure the pressure difference from any source other than the Hyperbolic Elbow. The resistance of the electrical meter body may be measured indirectly instead of by the Hyperbo-Electric Recorder; e. g., a voltmeter across the meter body may be used as this indirect method, if a constant voltage is impressed upon this meter body in series with a constant resistance. This so-called Voltmeter type flow meter as distinguished from our Wheatstone bridge type is actually offered for cases where highest accuracy and automatic corrections are not required. A constant voltage regulator can be furnished which will add somewhat to the cost of the Voltmeter type of flow meter. This type has still the advantages of our regular electrical meter body with the same large number of contacts and of the Hyperbolic Elbow as an accurate source of pressure difference. Where only *relative* flow *comparisons* are to be made within 10% of each other, orifices may be used with the electrical meter bodies and the Voltmeter type recorder without any voltage regulator.

It is thus apparent that any flow measurement may be made with any degree of accuracy by the use of the proper type of Hyperbo-Electric Flow Meter, which is exactly what the organizers of the Hyperbo-Electric Flow Meter Co. have been aiming for in the many years of hard work they have devoted to the development of these flow meters.

SOCIETIES

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Due to the custom of having leases expire on May 1st, Theta Xi finds itself without a house for the last month of school. September 1st will find us settled again on the boulevard—in a home Theta Xi can call its own.

THE UMEN

The Umen which is now in the second year of its existence, has been successful both from a social and from a scholastic standpoint. During the past year several smokers and other affairs have been held, but they were evidently not detrimental to the Umen average of 89.1 per cent.

The members are looking forward to increased activity and success for the coming year.

RHO DELTA RHO

The spring weather has made us more or less apathetic to social functions; nevertheless, the time thus made available has not all been spent in trying to raise our scholastic averages. What we have missed in a social way we have more than made up for in athletic activities. Tennis and baseball have come into their own.

The Dads' Banquet came up to our fullest expectations. The final smoker of the year was held on April 14, and served to while away a very pleasant evening. Initiation will be held on May 19; and the initiation banquet, followed by a theater party, will be held on May 26.

ARMOUR TECH BAND

The Armour Tech Band is the latest organization to take A. I. T. by storm. Organized for the purpose of putting punch in Armour spirit, the band's success has been phenomenal. At its first appearance at a recent mass meeting it was greeted with wild cheers, part of which enthusiasm was due to the dress uniform, consisting of white duck trousers and blue coats.

Since that time it has been received with equal enthusiasm at the A. I. T. and Wisconsin game, and at the event of all events, the Home Concert.

Under the able guidance of W. B. Douglas, '24, and provided with the motive power of high purpose and the enthusiasm and hearty co-operation of its members, the band has been piloted through its infancy with a marked degree of success. The slogan now is "A Fifty-Piece Band for 1924." Bring out your horn and shine her up!

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Since the March issue of the ENGINEER, the Armour Branch has had two meetings. At the first, Morris Spector presented some very interesting information on "Stage Illumination." At the second, Mr. Holmstedt, of the Western Electric Co., showed four reels of moving pictures and delivered a lecture on "The Manufacture of Communicating Apparatus." In spite of a radio lecture in competition, the attendance was good. If possible, we will see more of Mr. Holmstedt's moving pictures.

It was planned to have a smoker this spring, but as yet no date has been set. The one held last fall was a big success, so watch the bulletin board for the announcement of this one.

FIRE PROTECTION SOCIETY

On the evening of March 29 the "Fire Protect" smoker was held at the Theta Xi house. Our own jazz band furnished the entertainment during the early part of the evening. The remainder of the program included a moving picture (the film was approved by both the Underwriters' Laboratories and by Professor Finnegan), an exhibit of card stunts by Mr. Brown, the elder brother of one of our members, and speeches by President Raymond and Professor Finnegan. The climax, of course, was composed of "eats" and cigars.

On April 19, Mr. C. R. Welborn, of the Underwriters' Laboratories, spoke to us on the subject of "Oil Burners." Mr. Welborn has done a great deal of work in determining the fire hazards of these devices, and his experience enabled him to give a very interesting talk.

WESTERN SOCIETY OF ENGINEERS

The Armour Branch of the Western Society of Engineers upheld its reputation when Dr. Lawton, of the Sheldon School, was presented on March 15. His talk, "The Preliminary Survey," was most interesting; the subject dealt with the preliminary survey of life, a check-up on the milestones of success. Dr. Lawton possesses the ability to put his ideas over with a humorous touch that is delightful.

Then for the meeting of April 19, a surprise was sprung: Mr. H. E. Roulfs, President of the Merton Institute of Chicago, spoke on "Sizing Up the Man for the Job." Mr. Roulfs explained how organizations today are picking men for positions. This talk was enjoyed by one hundred and twenty-five students, and it was probably the most entertaining meeting of the year.

The Society feels that a very successful year has been completed. The annual election of officers will be held on May 3, and plans will then be made for the year to come.

ALUMNI NOTES

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The idea of a close relationship between the departmental engineering societies is an excellent one, and one which might well be taken up by the Armour Tech societies.

COLLEGE NOTES

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one. Beside Mr. Schommer the entertainers will be Mr. Bruce Amsbary, Mr. Charles Hitchcock, whose fame is only slightly exceeded by that of his brother Raymond, Master Francis Goetz, and a large Jazz Orchestra. The eats, are guaranteed upon a money refunded basis both as to quality and quantity. As for drinks, nothing dryer than water will be served.

On April 11, President Raymond spoke before the faculty and students of Lake Forest College, upon the subject, "Engineering as a Vocation." Dr. Raymond's address is one of a series of similar addresses upon the subject of various professions which is being presented to the students of Lake Forest College.

Professor McCormack returned to his Alma Mater, Drake University, on April 19, to be one of the foundation members initiated into Phi Beta Kappa. Thirty alumni of that university were so honored.

Professor J. C. Penn represented A. I. T. at the meeting of the Illinois Association of Collegiate Registrars held on April 16 at Bradley Polytech.

ENGINEERING MAJORS

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wise student if he so elects. However, he will find that that will not be the case. Mastery of himself physically will bring to him such an investment in health and endurance that study will be easy and accomplishment certain.

You may have all the wisdom in the world, but without adequate means of expression no one will know it. There are two methods of expression—spoken and written. The first is by far the more important. The engineer who can talk well and convincingly has a wide advantage over one who cannot. If he can say things that people can understand, and say them in a manner that his listeners will enjoy hearing, he has it all over the other fellow. A clear, forceful expression goes a long way with the "Big Boss." My advice to you is to join every talking society that the school affords. Express yourself, not with wild talk, but with carefully thought out expressions that mirror a clear mind. Learn to match your wits against your fellow's. Train yourself to think quickly and accurately. It doesn't make much difference what subjects you use in this training, if you learn how to handle them logically and with conviction. Discuss and debate any subject that will help you drill your mind so that you can express yourself with credit. At some future date you will, no doubt, be called upon to convince a man or group of men who are looking to you for advice, that your course of reasoning warrants their investment. You can get quicker action and gain more confidence by talking to them convincingly, than you can by writing volumes of reports. They will judge you largely by the way in which you handle yourself. They not only get from you the facts which you want them to know, but they also get your spirit. The responsibilities they will place upon you and the confidence they will have in you will largely depend upon the impression which you create. I know a score of brilliant engineers who are in very mediocre positions because they do not know how to express themselves verbally. They can write the most wonderful reports, but these reports are usually so awe-inspiring that they frighten rather than convince. I also know a score of other men who are not nearly as bright, but they are much farther ahead in their profession because they can think clearly and express themselves convincingly. Your school will give you plenty of opportunities to develop this phase of your training, although it may not be insisted upon in the list of your credits.

Next to the ability to talk, and almost as important, is the ability to write. A clearly written expression of thought goes a long way towards winning your battle. The command of the English language is vitally important. It is the vehicle that will carry your knowledge and ability wherever and whenever you want it known. If your mode of expression is sloppy, loose jointed, and illogical, it will portray that sort of an individual as its author. If it is clear, logical, well constructed, and vitally to the point, it will picture that kind of a man to the reader. In the practice of your profession you will associate with well educated men. The men who will have the most influence on your success will be equipped with minds full of broad knowledge, and they will expect you to be equally well equipped. If you expect to meet them on an equal plane you must have that same kind of a well stored mind. I have noticed that most successful engineers carry and read good books, and that these books cover a wide range of subjects. Their vocabularies are large and the words which they use in expressing themselves are full of forceful meaning. The most serious regret I have relative to my college training is that I did not appreciate this phase of it. This neglect has made practically all my efforts less effective than they would have been otherwise. And it has been extremely difficult to make up this deficiency in training.

No matter what your problem or study is, learn to identify and classify FACTS. As I am writing this, rolling across the Kansas prairies, the man across the aisle from me is playing solitaire. He has won the game repeatedly because he is fudging and cheating. He doesn't seem to have the nerve to face the cards when they are stacked against him. A great many men go through life on that basis. The hollow success that they think they have is mostly mental, and not actual. Your mind may be a very brilliant one, but it won't get you very far if you fudge on the truth. The whole engineering profession and the whole basis of science are founded upon the identification and proper classification of actually existing facts, and building upon them for truthful answers.

I believe it is safe to say that you will not have a chance to use five per cent of the knowledge that you are gathering. However, if you learn how and where to get knowledge when it is needed, you have accomplished the real purpose of your training. Cultivate your ability to identify the knowledge that is needed to solve a problem, and learn enough about the location of knowledge to be able to find it when wanted, rather than try to make yourself an encyclopedia of engineering data. The probability is that there won't be one chance in a hundred of your ever being asked to extract the cube root of anything, but it will be mighty important for you to know when problems can be solved by having their cube root extracted.

If you are honest with your school and your instructors you can not fail to get all the engineering, scientific, and mathematical training that you will need, and maybe more than is actually necessary. However, if in getting this training, you are forced to neglect the fundamentals that I have outlined above, your whole education will be less effective and even lost entirely, due to the lack of the physical and mental equipment necessary to express it.

ARMOUR TECH RADIO STATION "9YL"

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sive equipment, and therefore a correspondingly better station. It feels that it has done well with the material and apparatus it has had available. It also wishes to take this opportunity to thank publicly the Physics Department in the persons of Professor Wilcox, who has given unstintingly of his time and apparatus; President Raymond and Mr. Allison, who have aided both morally and financially; and also various members of the faculty and student body who have been consulted from time to time. The Club also wishes to extend an invitation to the faculty and student body to inspect Station 9YL and to attend the Club meetings, many of which are graced by speakers of prominence in the radio field.

BETTER LIGHTING NEEDED IN INDUSTRIAL PLANTS.

In a paper read before the Illuminating Engineering Society, February, 1920, entitled, "A Survey of Industrial Lighting in Fifteen States," R. O. Eastman submitted some very interesting data regarding the lighting conditions in industrial institutions. The survey comprises some 446 institutions, in which lighting was considered by 55.4% as being vitally important, and by 31.6% as being moderately important, and by 13% as being of little importance. Practically 58% considered that lighting was as important as power in the operation of the plant, and a small proportion would give more attention to lighting than to anything else.

In considering the present condition of lighting as found in the various plants, only 9% ranked as excellent, about ⅓ ranked as good, 29% fair, 18.8% poor, 3.5% very poor, and 7.8% partly good and partly poor. It was found that the lighting in the offices was far superior to that in the shops; 19% being excellent, 36% good, 31% fair, and only 13% poor and none very poor.

On consulting the executives regarding what factors were most important in considering lighting, the following facts were revealed: Increase of production 79.4%, decrease of spoilage 71.1%, prevention of accidents 59.5%, improvement of good discipline 51.2%, and improvement of hygienic conditions 41.4%. Manufacturers who have good lighting appreciated its value largely from the standpoint of its stimulating effect upon output.

There is no question that any intelligent man who carefully considers the necessity for good lighting in an industrial plant, will agree that it is impossible for a person to do as good work, either in quality or quantity, in poor light as in good light, but yet the result of a careful analysis discloses the fact that only about 40% of industrial plants are furnishing good light to their workers and 60% are operating under poor lighting. It is hard to understand why such a proportion of concerns can be satisfied with a condition which is universally admitted to be a curtailer of efficiency and a prolific causer of accidents. The principal cause of this condition is that those in charge of such establishments have not given the attention to lighting that it demands. They do not know what constitutes good lighting, and in their absorbing interest of other factors of production have overlooked a vital one.

Every safety official should deeply interest himself in the lighting of his plant and insist upon good lighting as much as good goggles, good guards and other necessary accident prevention equipment. Every production manager should insist upon good lighting because the efficiency of the working force is increased by the condition of the lighting furnished. The plant physician should examine the lighting, for eye strain and eye fatigue are directly affected by poor lighting, as is the hygienic condition. Well lighted plants are invariably cleaner than poor lighted places. Plants equipped with Factrolite Glass in all windows are well lighted.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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(*Signed*) LESTER E. GRUBE.

Sworn to and subscribed before me this 8th day of November, 1922.

(*Signed*) GEO. S. ALLISON.
Notary Public.

CHICAGO, November 8, 1922.

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